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AUTHOR Berkay, Paul James
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ABSTRACT

A study was conducted to determine whether deaf and hearing students generated different quantities of errors on word processing documents in a mainstreamed class. It also examined whether these students measured up to job-ready work quality standards. A literature review focused on the following topics: (1) needs assessment for deaf adult education; (2) methods and modes of classroom communication; (3) program and instructional models for postsecondary education of deaf adults; (4) support services; (5) effects of mainstreaming on deaf and hearing students; (6) comparison of mainstreamed and nonmainstreamed environments; and (7) issues related to typing and word processing. Subjects of the study were newly enrolled adult students (11 deaf and 11 hearing) from a mainstreamed WordPerfect word processing class. Six representative documents prepared by the students were selected for analysis. Mean scores for a total of 28 formatting and typographical errors were compared along with the total formatting errors, total typographical errors, and total overall errors. Data were analyzed using nonparametric statistics to compare the following: (1) average error rates by group for each document; (2) average error rates by group for all six documents; and (3) individual error averages with job-ready performance standards. Results indicated that deaf and hearing students generated similar performance errors and both deaf and hearing students met job-ready standards. (45 references) (YLB)

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A COMPARISON OF THE PERFORMANCE ERRORS OF DEAF AND HEARING STUDENTS IN A MAINSTREAMED ADULT EDUCATION WORD PROCESSING COURSE

Presented at
The California Educational Research
Association Annual Meeting
San Diego, California
November 1991

Paul James Berkay, M.S., Presenter
California State University Long Beach

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ABSTRACT

A COMPARISON OF THE PERFORMANCE ERRORS OF DEAF AND HEARING STUDENTS IN A MAINSTREAMED ADULT EDUCATION WORD PROCESSING COURSE

By

Paul James Berkay

August 1991

The purposes of this study were to determine whether (a) deaf and hearing students generated different quantities of errors on word processing documents in a mainstreamed class and (b) these students measured up to job-ready work quality standards. Subjects were 11 deaf and 11 hearing newly enrolled adult students from a mainstreamed WordPerfect word processing course. Six representative documents were selected for analysis. Mean scores for a total of 28 formatting and typographical errors were compared along with the total formatting errors, total typographical errors, and total overall errors. The data were analyzed using nonparametric

statistics to compare (a) average error rates by group for each document, (b) average error rates by group for all six documents, and (c) individual error averages with job-ready performance standards.

The results revealed that deaf and hearing students generated similar performance errors and that both deaf and hearing students met job-ready standards.

A COMPARISON OF THE PERFORMANCE ERRORS OF DEAF AND HEARING STUDENTS IN A MAINSTREAMED ADULT EDUCATION WORD PROCESSING COURSE

A THESIS

Presented to the Graduate School of Education

California State University, Long Beach

In Partial Fulfillment

of the Requirements for the Degree

Master of Science

By Paul James Berkay

BA, 1983, California State University, Long Beach

August 1991

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WE, THE UNDERSIGNED MEMBERS OF THE COMMITTEE,

HAVE APPROVED THIS THESIS

A COMPARISON OF THE PERFORMANCE ERRORS OF DEAF AND HEARING STUDENTS IN A MAINSTREAMED ADULT EDUCATION WORD PROCESSING COURSE

By

Paul James Berkay

COMMITTEE MEMBERS

Claudia R. Wright, Ph.D. (Chair)	Educational Psychology and Administration
Marquita Grenot-Scheyer, Ph.D.	Educational Psychology and Administration
Paul M. Culton, Ed.D.	Special Resource Center El Camino College

ACCEPTED AND APPROVED ON BEHALF OF THE UNIVERSITY

John P. Sikula, Ph.D.
Dean, Graduate School of Education

California State University, Long Beach

August 1991

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CHAPTER 1

THE PROBLEM

The Significance of the Problem

The Americans with Disabilities Act (ADA) signed into legislation by President George Bush in 1990 has contributed toward the full participation of citizens with disabilities in the mainstream of American life (U. S. Congress, 1990). One major focus of the ADA has been to make employment attainable to individuals with special needs. Such accessibility will not guarantee successful employment unless those with disabilities are properly trained to perform the work available. Thus, the vocational training of this target population becomes a crucial link to the achievement of the ultimate goals of the ADA.

In order to provide for an increase in the acquisition of jobs for people with disabilities, vocational training courses must also be made accessible. Some of these individuals require minimal training adaptations. For example, students with physical handicaps may need facility accommodations (e.g., wheelchair ramps) and possibly

special alterations to classroom equipment (e.g., computers). Other special needs groups will be more difficult to accommodate for various reasons. The accommodation of deaf students, for example, presents several challenges, such as the removal of communication barriers and the adaptation of reading materials.

Deaf adults represent one segment of the hearing-impaired student population in need of such adaptations. The need to provide job training for deaf adults could be met partially through the adult education programs offered by public school systems. Unfortunately, the number of adult education models for deaf students is scarce, and the paucity of models published in the literature has been a factor in limiting the ability of school districts to implement effective programs.

Although the adult education system has not made great strides in serving deaf students, some educational models have been developed and implemented in colleges and universities across the country. An examination of these models reveals several possible methods of accommodating deaf adults. Some examples follow:

1. Separate vocational courses for deaf students could be offered with an instructor proficient in sign language.

2. Deaf students could be mainstreamed into a hearing classroom with an interpreter (sign language or oral).

3. Adaptive devices, such as amplification systems or hearing aids, could be used to facilitate communication with some students.

4. Technology, such as a real-time graphics display (RTGD)(live captioning through a court reporter) or captioned videotapes, can be employed to assist in communication.

Unfortunately, such accommodations are expensive and often beyond the budget of many adult school programs. An alternative option to those cited has been explored by this author. This option includes utilizing a model of Direct Instructor Communication in ASL (American Sign Language). This model involves no additional budgetary expense. All that is needed is an instructor who is fluent both in sign language and oral English and can communicate with both deaf and hearing students in a mainstreamed classroom. The effectiveness of this model for deaf students has been demonstrated in terms of student attendance and performance when compared to hearing students enrolled in the same course (Berkay, 1990).

Although this model achieved some measure of success, the original pilot study was not designed to demonstrate the model's effectiveness in producing job-ready students.

The measure of performance used in the pilot evaluated the quantity of the students' work, but not the quality. Subjects were expected to produce completed documents in order to earn a certificate of completion. Although attention was paid to the work quality and mistakes were pointed out to the students, the final products were not closely monitored for errors. Students were not graded on the quality of their work, and they were not given specific quality standards to achieve. Certificates of completion were granted to students who finished a specific number of exercises with reasonable comprehension of the material. Job readiness had not been the target goal of this course, as many of the students took the class for personal enjoyment. There was no follow-up to determine how many students may have sought, found, and maintained employment. A motivation to become job ready was not a prerequisite for enrollment in the class. The instructor's competency and the success of the course were both determined by the number of students enrolled and the rate of attendance.

The investigation which has served as the focus of this thesis was designed to explore the possibility of restructuring this course to produce job-ready students. It was first found necessary to determine whether the original course was successful in graduating students

meeting work-quality standards. If not, then changes to the course would need to be made in order to produce the desired levels of performance. In order to measure job-readiness, the focus of this study was on the quality, rather than on the quantity of work completed (which was determined in the previous study). Quality assessments were not examined during the pilot study, but as relevant data from that study were available for further analysis, it was possible to examine whether either group (deaf or hearing) produced a quality of work that would meet job-ready standards.

Several outcomes were possible and are described as follows:

1. It may have been found that poor quality work below entry-level standards was produced by both deaf and hearing students in the pilot study. If this were the case, the teaching materials and methods used in the course would need to be modified for all students, both deaf and hearing, in order to produce job-ready students.

2. Both groups may have produced a high quality of work that met acceptable standards and no adaptations would be necessary for the teaching materials and methods.

3. It may have been found that the deaf students produced a high quality of work, while the hearing students performed below entry-level standards. Under such

conditions, adaptations would be necessary for the teaching materials and methods to assist the hearing students' performance.

4. The deaf students could have produced a lower quality of work than the hearing students. If only the deaf students performed below standard, the teaching materials and methods would need to be adapted for the deaf group only.

If the examination of the data from this pilot study produced Outcome 4, one might conclude that the Direct Instructor Communication model that was used with this pilot was an inadequate approach for producing job-ready deaf students. However, this conclusion would overlook the fact that this model focused on adaptations in the modalities of communications with the students, not the teaching-related materials and methods themselves (which were identical for both deaf and hearing students). Lower work quality on the part of the deaf students might be related to teaching materials and methods and not related to the communication strategies employed.

Consider that inappropriate teaching materials and methods not meeting the educational needs of the deaf students could have generated a low quality of work. Some examples are as follows:

1. The textbooks used in this course may have been inappropriate for some of the deaf students. It has been noted in the literature that many deaf students read at lower grade levels than their hearing peers (Babbidge et al., 1965). Thus, the reading level of the textbook may have been too difficult for some or all of the deaf participants. The text may also have contained idioms and expressions that were unfamiliar to some deaf students.

2. As many deaf students have difficulty reading, the textbook may have needed less text and more visuals.

3. Further, because many deaf students receive most communication visually (Baker & Cokely, 1980), they may learn differently and fail to understand teaching materials and methods designed for hearing students.

If the course was found to produce below entry-level standard work quality for only the deaf students, corrective adaptations would need to go beyond a communication adaptation model, such as the Direct Instructor Communication model. An appropriate model to remedy this inconsistency could provide adaptation of both the teaching materials and teaching methods of this course. The first step in determining the necessary adaptations would be in comparing the deaf and hearing students' work quality performance, as previously discussed.

There are two benefits that could be realized from making such a comparison. One would be that the resulting information could provide some direction for adapting the teaching materials and methods of the piloted course or other such word processing courses for deaf adults in a mainstreamed environment. A second benefit could be that improved performance and quality of work by deaf students resulting from such adaptations could produce job-ready deaf adults who are able to obtain and maintain successful employment in the word processing field.

Purpose

There were two major purposes identified for this study. First, a comparison was made to identify the difference, if any, in the quantity of performance errors made by deaf and hearing students. Second, the extent to which all students, both deaf and hearing, in the mainstreamed pilot word processing course measured up to job ready work-quality standards was examined. A tertiary concern was to make recommendations based on the results that could be used to make any necessary adaptations to the teaching materials and methods of this course.

Research Questions and Hypotheses

For the purposes of this study, two research questions were posed:

1. Do deaf and hearing students, provided with identical teaching materials and methods and clear instructor communication, produce different quantities of performance errors on word processing documents in a mainstreamed adult education classroom?

2. Did the deaf and hearing students in the pilot study for the Direct Instructor Communication in ASL model perform a quality of work that meets entry-level word processing job requirements?

Four research hypotheses were designed in connection with the above-mentioned research questions.

Hypothesis 1

The deaf students will produce more errors than do hearing students on word processing documents. The underlying rationale for this hypothesis is that many deaf students tend to demonstrate lower English comprehension then do hearing students, and difficulty in following the textbook on the part of the deaf subjects might tend to result in more errors related to task performance.

Hypothesis 2

Fewer than half of the students in each group will meet job-ready standards.

Hypothesis 3

More hearing students than deaf students will meet job-ready standards.

Hypothesis 4

Neither group will meet job-ready standards.

Definitions of Terms

The key terms used in this study were defined as follows:

American Sign Language (ASL)

American Sign Language (ASL) is the native or first language used by approximately 250,000 to 500,000 deaf people in the United States and Canada (Baker & Cokely, 1980). Its grammar structure is not based on the English language. ASL is a visually-based, rather than aurally-based language.

Aural Rehabilitation

Aural rehabilitation is the process of training a hearing-impaired person to make optimum use of whatever residual hearing he or she may possess through the use of amplification devices (e.g., hearing aids) and appropriate teaching methods and devices.

Codes

Codes are words in brackets that appear on the Reveal Code screen in WordPerfect and visually represent commands embedded in the document not visible on the main document screen (e.g., [HRT] for Hard Return).

Communication Method

The term communication method will be defined as the way the instructor communicates with the deaf students in a mainstreamed class.

Direct Instructor Communication Model

The Direct Instructor Communication Model in American Sign Language (ASL) is a model developed by this author to facilitate communication between an instructor and deaf students in a mainstreamed adult education class.

FM System

An FM system amplifies oral classroom instruction through wireless frequency modulation (FM). The instructor wears a microphone transmitter, while each deaf student connects a receiver to his or her own hearing aid (Bricault, Stinson, & Gauger, 1985).

Formatting Errors

Formatting errors will be defined as those errors that affect the layout of a typed document (how it appears on

the page), including (a) substitution errors, (b) omission errors, (c) extraneous errors, and (d) miscellaneous formatting errors. These four categories are defined as follows:

Substitution errors. Substitution errors are those that involve the use of incorrect or unconventional commands or keys in place of the correct ones (e.g., using spaces in place of tabs).

Omission errors. Omission errors are those made when a required command or key is not used in the preparation of text. Unlike substitution errors, incorrect commands or keys are not used in place of the proper ones (e.g., tabs are omitted at the beginning of paragraphs requiring indentation on the first line).

Extraneous errors. Extraneous errors are those made when commands or keys are used in error. They are not used in place of correct commands or keys, as in substitution errors (e.g., extra Hard Returns are placed at the top of the document, rather than setting the top margin with the appropriate commands), but involve the addition of commands or keys not related to the formatting task.

Miscellaneous formatting errors. Miscellaneous formatting errors are all other errors that do not involve

the incorrect substitution, omission, or extraneous use of commands or keys (e.g., failing to clear the screen before retrieving a new document).

Job-ready Word Processing Student

A job-ready word processing student is one who possesses the skills to acquire and maintain an entry-level job in the field of word processing.

Loop System

A loop system is an amplification system whereby the classroom is wired and each student plugs a headset into the system (Bricault et al., 1985).

Mainstreamed Classroom

A mainstreamed classroom will be defined as one that enrolls both deaf and hearing students.

Manually Coded English (MCE)

Manually Coded English (MCE) is "a general term which refers to any of the artificially developed manual codes for representing English" (Baker & Cokely, 1980, p. 460).

Meeting Job-ready Performance Standards

Meeting job-ready performance standards for an entry-level word processing position will be operationally defined as averaging no more than five formatting errors,

five typographical errors, or eight total errors per document.

Non-mainstreamed Classroom

A non-mainstreamed classroom will be defined as one that contains only hearing students or only deaf students.

Paired Commands

Paired commands are those that show a pair of codes on the Reveal Code screen and contain text to be affected inside the pair of codes (e.g., Bold--[B]affected text[b]).

Pidgin Signed English (PSE)

Pidgin Signed English (PSE) is described as "varieties of signing used by deaf and hearing people which combine certain elements of both ASL and English" (Baker & Cokely, 1980, p. 461).

Real-time Graphics Display (RTGD)

Real-time Graphics Display (RTGD) is live captioning through the use of a modified stenotype machine and a computer program that produces a verbatim transcript. Simultaneously with delivery of speech, a stenographer types captions that appear live on a television screen for immediate viewing by an audience.

Reveal Code Screen

The Reveal Code screen is a special screen in WordPerfect that shows text and previously hidden codes that control the formatting of the text.

Sign Insert

A sign insert is created by a special effect that superimposes a sign language interpreter into the corner of a television screen.

Signed English

Signed English is "a manual code for English . . . intended to be used with young deaf students; in general, a 'one sign for one word' approach is used and the number of signed English affixes is limited" (Baker & Cokely, 1980, p. 461).

Signing Exact English (SEE)

Signing Exact English (SEE) is "a manual code for English . . . which tries to achieve a one-to-one correspondence between English words or syllables and a single sign for each word or syllable" (Baker & Cokely, 1980, p. 461).

Simultaneous Communication

Simultaneous Communication is the process of speaking and signing at the same time.

Single Commands

Single commands are those that display single codes on the Reveal Code screen. They are not in pairs. Some of these commands perform functions that change the appearance or format of text (e.g., Double Space). Text to be affected by a single command must appear after the code in the Reveal Code screen because commands that change text only affect text that follows them.

Teaching Materials and Methods

Teaching materials and methods will be defined as the textbook, teaching materials, and teaching methods employed by the instructor.

VOX System

A modified loop system (Bricault et al., 1985).

Work Quality

For purposes of this study, work quality was operationalized as the number of formatting and typographical errors found in the students' documents.

Conceptual Assumptions

The two conceptual assumptions that follow are considered to be implicit in this study:

1. WordPerfect: Tutorial & Applications by Mary Alice Eisch (1988), a student textbook for WordPerfect

Version 4.1/4.2, contains documents that are representative of those produced on the job by professional word processors.

2. Although other instructional models are available for teaching deaf students, the Direct Instructor Communication in ASL model was considered to be the most economical for an adult school budget. There are no added costs involved in the use of this model.

Overview of the Remainder of the Thesis

Chapter 2 presents a literature review related to deaf instructional models and performance comparisons between groups of deaf and hearing students. An examination of work quality in typing and word processing is also included.

Chapter 3 will outline the word processing document selection and analysis procedures and the method of testing the hypotheses explained in Chapter 1. Included will be definitions of performance errors in word processing documents, an explanation of the performance criteria used to evaluate the job-readiness of students, a description of the subjects, and an outline of the statistical procedures utilized.

In Chapter 4, the results revealed by the data will be presented, along with an analysis and an interpretation of the results.

In Chapter 5, the last chapter, a summary of the investigation will be presented. In addition, the results and their implications will be discussed with suggestions for their applicability to the adaptation of the teaching materials and methods of a word processing course designed to produce job-ready performance. Recommendations for future research will also be presented.

CHAPTER 2

A REVIEW OF THE LITERATURE

Introduction

Although much has been written on the education of deaf children, there is a paucity of literature on deaf adult education. In order to expand this review, literature from other postsecondary settings in which programs for deaf adults have been implemented, such as universities, colleges, and vocational schools, will also be examined.

In addition to a scarcity of deaf adult education research, actual continuing education programs are also uncommon. A major problem faced by the deaf adult desiring continuing education is the insufficient number of adult education programs for the deaf (Khan, 1987; Larson, 1982; Malone, 1986; Schein, Delk, Lipman, Bowe, & Freebairn, 1976). Even in those programs that are available, there are a limited number of courses from which to choose that have been adapted for deaf students (Schein et al., 1976). This is unfortunate because deaf students

request the same types and varieties of courses as do hearing students (Bateman, 1987; Schein et al., 1976).

Although deaf students may require special accommodations in a mainstreamed classroom, they possess the same degree of intelligence as is present in the hearing population (Culton, 1975; Malone, 1986). Despite a normal level of intelligence, however, deaf students do not always perform on an equal level with hearing students, depending on the subject. For example, deaf students may struggle with language and vocabulary (Culton, 1975). It has been determined that the average deaf adult does not read above a sixth-grade level (Babbidge et al., 1965; Larson, 1982). In non-language related functioning, however, they perform on an equal level with their hearing peers (Malone, 1986; Rosenberg, 1974).

This chapter is divided into seven sections. The first addresses needs assessment surveys primarily administered to potential deaf adult education consumers. The second section explains methods and modes of classroom communication utilized by teachers, interpreters, hearing students, and deaf students. In the third part, program models and instructional models for the postsecondary education of deaf adults are described. Next, support services used to accommodate deaf students in mainstreamed classrooms are examined. The fifth section explores

mainstreaming and its effects on deaf and hearing students, and mainstreamed and non-mainstreamed environments are compared in the sixth. In the last section, issues related to typing and word processing are outlined.

These seven areas were chosen for review because they all have contributed information leading to the development of the Direct Instructor Communication model examined in this study. One of the first steps in the model's development was to determine the adult education needs of the deaf community. Various methods and modes of communication were examined to determine the one best suited for this model. Next, existing programs, instructional models, and support services were reviewed to determine (a) whether a need existed for new models and (b) which components could be incorporated into the new model being developed. During that review, existing programs were examined to determine whether mainstreaming deaf students into classes with hearing students would result in negative effects on either group. Mainstreamed and non-mainstreamed classrooms were also compared to determine the optimal environment. Finally, since the original pilot study was conducted with a word processing curriculum, literature related to typing and computer courses was reviewed.

Much of the literature reviewed for this study refers to populations of deaf university students whose educational levels and needs cannot be assumed to be identical to those of the subjects in this study who were enrolled in an adult school class. But the deaf adult populations included in the studies were the most nearly analogous to a deaf adult education population that could be found in the existing literature.

Needs Assessment for Deaf Adult Education

The goal of the ADA is to integrate individuals with disabilities into the mainstream of American life (U. S. Congress, 1990). Continuing education is necessary for deaf adults in order for them to keep up with politics, society, and changes in industry (Bateman, 1987).

On occasion, deaf adults and deaf professionals are surveyed as to their needs and priorities for future deaf adult education programs. Costello (1977) described one such assessment that obtained the opinions of deaf community members (n = 574) and hearing professionals (n = 337) in 15 cities in the United States. In each city, a list of 18 goals were evaluated by the subjects. A game board and playing pieces assisted the subjects in the prioritization of goals. Both groups agreed on the top six goals which were (a) improving language abilities, (b) improving finance and property management, (c) increasing job status

and salary, (d) improving relationships and communication with hearing people, (e) diminishing the number of unemployed deaf people, and (f) creating better family relationships.

Another survey was conducted through the mailing of a deaf adult education questionnaire to deaf adults across the country (Schein et al., 1976). The respondents (n = 641) thought that there were too few deaf adult education programs offered and that the selection of courses was limited. The deaf respondents' preference for courses was similar to that of the hearing population.

Bambach (1983) also questioned 150 deaf adults in northeastern Pennsylvania to determine their continuing educational needs. Subjects were interviewed in sign language and responded in writing. Most of the subjects reported that they were interested in attending a variety of academic, vocational, and general interest courses, and a majority preferred night classes held during the week.

A Review of Methods and Modes for Classroom Communication

There is a broad range of communication methods that may be utilized with deaf students in a postsecondary classroom. It is apparent that deaf students have varying needs and that all possible method combinations should be

considered when developing educational models for this population (Foster & Elliot, 1986; Heffernan, 1979).

Deaf students can receive instruction though various methods. Some deaf students read instructions on paper or on a screen through the use of captioned videotapes or real-time graphic display. Other students communicate directly with the instructor through the use of sign language or indirectly through a sign language interpreter. Some studies have been conducted to compare the various methods of receiving instruction.

Captioned vs. Direct Instruction vs. Print

The effects of captioned instructional television, direct sign language instruction, and written instruction on comprehension were examined using 203 students from the National Technical Institute of the Deaf (NTID) (Dowaliby, Enders, Schragle, & Verlinde, 1984). A 10-minute photography film was used with the three instructional modes as follows: (a) a captioned videotape, (b) a printed copy of the film's script, and (c) direct sign language instruction from the film's script. In the latter, the instructor communicated directly in sign language to the students without the assistance of an interpreter. Each of the three modes was delivered with either high or low structure. High structure contained advance organizers

and summaries. Each subject was assigned one of the six treatments. A 19-question test was administered to each subject following the treatment. The print treatment resulted in significantly higher scores than the other two treatments. The high structure format only produced significantly higher scores in the classroom instruction mode of delivery.

Print vs. Signed

The effects of print, Manually Coded English (MCE), and ASL presentation were studied using 45 prelingually deaf Northern Illinois University students, ages 18-24 (Ouellette & Sendelbaugh, 1982). Subjects were administered a 5-minute story from the Stanford Achievement Test for the Hearing Impaired, Level 5, Form A. Each of the three groups received the story through a different mode of communication. The three modes utilized were (a) typed copy, (b) MCE videotape, and (c) ASL videotape. All subjects received typed questions. In addition, the MCE group viewed the questions in MCE, while the ASL group reviewed questions presented in ASL. Subjects with the print treatment performed significantly better than those receiving the ASL treatment. There was no significant difference reported between the MCE group and either of the other two groups. The authors suggested that many of the subjects may have been unfamiliar with ASL. Most of

the subjects had graduated from secondary programs using Signed English and may have had little contact with deaf adults using ASL. Only two subjects reported that they had been raised by deaf parents.

Signed vs. Captioned Videotape

Another comparison of instructional methods was performed by Tomasetti, Beck, and Clearwater (1983). The effects of signed and captioned CPR training videotape on CPR skill retention was examined using 60 deaf Gallaudet College students and 30 hearing University of Maryland students. Each subject participated in a 4-hour CPR training class that combined instruction, practice, and a training videotape. The hearing subjects participated in the standard course. Each deaf subject was randomly assigned to one of the following treatments: (a) noncaptioned videotape, (b) captioned videotape, and (c) live sign language interpreted videotape. Each of the three deaf treatments included direct sign language instruction from the teacher. A posttest was given following viewing. A 4-month follow-up test identical to the posttest was also administered to each subject. A 14-question multiple-choice cognitive test was administered. A performance tape generated by a monitor connected to the mannequin (used for mouth-to-mouth resuscitation) and a checklist were used to assess psychomotor skills.

Univariate (ANOVA) and covariate (ANCOVA) analyses revealed the following:

1. There were no statistically significant differences among groups on the initial cognitive scores.

2. There was a significant loss of retention between the posttest and the follow-up for the total sample.

3. The sign and hearing groups demonstrated significantly higher retention of cognitive scores than did the noncaptioned group.

4. During the psychomotor posttest, the hearing group scored significantly higher than did the noncaptioned and sign groups.

5. The sign group demonstrated a significantly higher psychomotor retention score than did the noncaptioned group.

6. The mean percentages of improvement from posttest to follow-up were established and used as the covariate in a series of ANCOVA procedures which revealed that (a) on the cognitive test, the sign group showed a significantly greater amount of retention than either the uncaptioned or captioned groups; (b) the hearing group showed a significantly higher level of cognitive retention than that of the noncaptioned group; and (c) the sign group showed a significantly higher level of psychomotor retention than that obtained by the hearing group or by either of the

other two deaf groups. Further, psychomotor skills were split into two sections for scoring: (a) diagnostic and (b) performance. The hearing group performed significantly higher than did the noncaptioned group during the diagnostic posttest. On the diagnostic follow-up, the sign group scored significantly higher than did the noncaptioned group. The scores for the performance sections revealed no statistically significant differences between the two groups.

Use of Sign Language

Choosing the proper method of instruction is not the only consideration when designing educational programs for deaf students. Within a single method, such as sign language interpreting, there are many variations that can be employed. Possibilities include American Sign Language (ASL), Signed English, Pidgin Signed English (PSE), and Signing Exact English (SEE). Some studies have been devoted to comparing the effectiveness of these various sign language forms with different forms as used by interpreters. For example, the effect of ASL versus Signed English upon test scores was studied using 29 deaf college students at California State University, Northridge (CSUN) (Murphy & Fleischer, 1976). A second component of this study was to determine the effect of the subjects' mode of preference on their test results. Each subject viewed a

videotape of two interpreted lectures, each in a different sign language mode. The two modes were (a) ASL and (b) Signed English. Only half of the subjects were assigned a treatment in their mode of preference. Upon completion of each lecture, all subjects took a multiple-choice test based on the videotaped material. No statistically significant differences related either to mode or preference were found.

Another signing style comparison was conducted by Fleischer and Cottrell (1976). The effect of ASL vs. Signed English interpreting as well as the effect of the interpreter's prior knowledge of the class material was studied using 40 deaf students at CSUN. The four conditions studied were (a) an ASL interpreter with no prior knowledge of the class material, (b) an ASL interpreter with prior knowledge of the class material, (c) a Signed English interpreter with no prior knowledge of class material, and (d) a Signed English interpreter with prior knowledge of the class material. The subjects had at least 70 db loss in the better ear and could not comprehend speech through hearing. Each treatment included two stories from one live interpreter using one of the four conditions. Each subject was exposed to all four treatments. A 10-question pencil and paper test was developed for each story. There were no statistically significant

differences found among comparisons of any of the four conditions. The total ASL score was significantly higher than the total Signed English score. The individual mean scores of each condition ranked the four conditions as follows from highest to lowest:

1. ASL with prior knowledge of class material.
2. ASL without prior knowledge of class material.
3. Signed English with prior knowledge.
4. Signed English without prior knowledge.

Even if the signing style used by an interpreter can be agreed upon, there is still debate on whether an interpreter should be used at all in the classroom. Alternatives have occasionally been compared with the use of an interpreter. Some educators believe that it is more effective for the instructor in a mainstreamed classroom to communicate directly to <u>all</u> students through the use of Simultaneous Communication (signing and voicing at the same time) in lieu of an interpreter. The effect of oral-manual interpreted communication versus oral-manual Simultaneous Communication was examined using 296 hard-of-hearing and profoundly deaf National Technical Institute of the Deaf (NTID) students (Caccamise & Blasdell, 1977). All subjects received both treatments. Each subject viewed two videotaped sections of a sentence list, one section in each treatment. The two treatments were

(a) Simultaneous Communication with audio from the presenter and (b) audio and lip movement from the presenter with manual communication and lip movement from an interpreter. Students were instructed to write information delivered by the presenter. Superior performance was found under the Simultaneous Communication condition. Students with hearing aids performed better under both conditions than did students without hearing aids.

In addition to interpreting live instruction, many interpreters are called upon to interpret live during the presentation of videotapes and films. Some deaf professionals believe that captioning these materials is preferable. In light of this debate, Norwood (1976) examined the effect of captioned and sign insert videotapes using deaf college graduates (n = 26) and deaf high school graduates (n = 26) from Washington, DC. Half of the subjects viewed a captioned news broadcast, and the other half viewed a sign insert adaptation. Each subject was given a 20-question written test following the viewing of the videotape. The college graduates performed significantly better than did the high school graduates with both formats. Subjects viewing the captions received significantly higher test scores than those viewing the sign insert. Ninety percent of all subjects preferred captions over the sign insert format.

Use of Real-time Graphics Display

Interpreting has also been compared to the use of a real-time graphics display (RTGD). The effects of RTGD, interpreting, and notetaking were studied using 121 mainstreamed hearing impaired students from NTID attending courses at the Rochester Institute of Technology (RIT) (Stinson, Stuckless, Henderson, & Miller, 1988). It should be noted that 100 of the students graduated from mainstreamed secondary programs, while 19 were from residential or day school programs. The other two subjects' backgrounds were not identified.

The instructional model for the RIT study included, in addition to an interpreter and notetakers, a professional stenographer who generated live captions on a television screen positioned in the front of the classroom. A modified stenotype machine and computer program produced the verbatim transcript generated through live captioning. After minor editing, a hard copy was made available for students at the conclusion of the class session.

All subjects were surveyed to ascertain their perceived percentage of comprehension of information delivered under four modes of communication. They were (a) RTGD live captioning, (b) RTGD hard copy class notes, (c) interpreters, and (d) notes from notetakers. Students

were then asked to select one of the four modes as a provided service if they were forced to choose a service.

In choosing only one of the support services, students graduating from mainstreamed secondary programs chose services in the following order: (a) RTGD live captioning, (b) RTGD printout, (c) interpreter, and (d) notetaker. Students formerly from a residential school setting choose services in the following order of frequency: (a) interpreter, (b) notetaker, (c) RTGD live captioning, and (d) RTGD hard copy. In addition, subjects rated their understanding of a lecture provided through RTGD live captioning higher than that obtained through the interpreter. In this analysis, the students also rated the RTGD hard copy as more helpful than the notetaker's notes.

Five years prior to the study by Stinson et al. (1988), the question of accuracy with RTGD led Stuckless (1983) to examine the accuracy of messages and delay time of an RTGD system used at NTID. The system was set up in 1982 for mainstreamed hearing impaired students at RIT. Ten months following implementation, a one-hour lecture was analyzed for error rate. Ninety-five percent accuracy in reproducing the lecture was determined. The delay time between speech and text appearance on the screen was also studied. A videotape was produced with live-captioned

text and audio from two lectures. Time coding was added to the videotape. An overall 5-second average delay time was discovered.

Use of Amplification Methods

In addition to captioning and RTGD, other technology is utilized to enhance communication for the deaf student in the postsecondary classroom. The preferences and performance comparisons of hearing aids, FM, and loop amplification systems by deaf adults were studied using deaf college students (n = 45) at the National Technical Institute of the Deaf (NTID) (Bricault, Stinson, & Gauger, 1985). All subjects were regular hearing aid users. For the three separate experiments in this study, the subjects enrolled in three non-mainstreamed classes had filled out questionnaires regarding their experience with the different assistive devices.

In Experiment 1, the deaf students (n = 12) compared two different brands of FM systems with their own hearing aids. Most students agreed that the FM systems were louder, but made it more difficult to hear classmates when compared to the use of hearing aids. A majority of the students in this experiment preferred using hearing aids.

In Experiment 2, an FM system, loop system, and hearing aids were compared by deaf students (n = 20). The preferred assistive devices, in order of preference, were

(a) hearing aids, (b) the loop system, and (c) the FM amplification device.

For Experiment 3, a VOX system, used for between-student communication and self-monitoring of speech, was designed. The VOX system, loop system, and hearing aids were compared by the deaf subjects (n = 13). The hearing aids made it easier to hear other students when compared to the other two devices. Hearing aids were preferred over both the VOX and loop systems.

It should be noted that the above-mentioned literature review does not provide an exhaustive description of all methods and modes of classroom communication. Such an undertaking is beyond the scope of this study. The purpose of this section, however, was to provide the reader with an overview of the various types of communication modalities employed and to provide a sense of the feasibility (or lack of feasibility) of such options.

Instructional Models and Program Models

As previously mentioned, there is a paucity of instructional and program models for the postsecondary education of deaf adult. The few studies available will be discussed in this section.

Instructional Models

Three models for classroom instruction have been discovered after a search of the literature: (a) Direct Instructor Communication in ASL model, (b) a mainstreamed typing course model, and (c) Dramatization/discussion model.

Direct Instructor Communication in ASL model. Berkay (1990) examined a method of instructor communication through the model of Direct Instructor Communication in ASL. The major components of this model are as follows:

1. The model was designed for a mainstreamed adult education word processing course with minimal lecture time and principal emphasis on individualized instruction.

2. The instructor communicates directly with the deaf students in ASL. An interpreter is not present.

3. Lectures, identical in content, are delivered once in ASL with no voice, and once in spoken English. Simultaneous Communication is used for brief announcements.

4. The deaf students' preference is used to determine communication with individual students. Either ASL without voice or Simultaneous Communication is used, depending on the needs of the student.

A pilot study of this model produced similar performance, attendance, and drop rate between a group of deaf

(n = 11) and hearing (n = 12) students enrolled in the class.

A mainstreamed typing course model. Another instructional model was proposed for teaching a mainstreamed college typing class with deaf students (Rosenberg, 1974). The following components are included in this model:

1. All lectures are presented with simultaneous fingerspelling and voice.

2. The teacher provides live demonstration for the students.

3. Visual media are used as often as possible. Overhead and slide projectors are utilized. The instructor displays transparencies, films, and filmstrips.

4. A few adaptive devices are suggested. To adapt rhythm records for deaf students, the instructor switches a light on and off to the beat of the music. To compensate for the inability to hear the carriage bell, a device hooked up to the bell mechanism vibrates the typewriter to indicate the need for a carriage return.

5. Deaf and hearing students are given an equal amount of instructional attention.

Dramatization/discussion model. The third model included in this review was developed for a workshop setting. The Dramatization/discussion model for the

education of deaf adults addresses the problems that arise when a guest speaker lectures to a deaf group with an interpreter (Tebo, 1984). Tebo considered the standard lecture format to be inadequate because the audience members are lectured at, rather than communicated with. The focus on the interpreter also takes away from making contact with the speaker.

To overcome these and other problems, a new model was developed that included the following components:

1. In lieu of one long lecture, there is an overview of the topic facilitated by the guest speaker followed by three simultaneous discussion groups on different topics.

2. Short skits are prepared and presented during the overview section. They may involve rehearsed actors and/or audience volunteers.

3. Deaf consumers are involved in the preparation of the workshops and serve as role players in the dramatizations, as well as leaders of the discussion groups.

4. All dramas and discussion groups are presented directly in ASL. For hearing participants who lack signing skills, an interpreter translates the signs into oral English.

5. Pauses are provided in the presentation for immediate questions and feedback.

Though no empirical study was performed on this model, Tebo reported that feedback sheets included positive comments. It was also stated that attendance improved when this model replaced the previous straight lecture with interpreter format.

Program Models

A Range of Options model. In addition to instructional models, some program models have been developed for the education of deaf adults. Foster and Elliot (1986) proposed a Range of Options model for postsecondary deaf students that offers a continuum of educational environments on the same campus. The three environments were (a) traditional classes without support services; (b) regular classes with support services, such as interpreters, notetakers, and tutors; and (c) special self-contained, modified courses. The rationale was that one single environment might not be suitable for all deaf individuals. It was thought that some students would concurrently use a combination of environments or tend to seek a change in environments over time. Foster and Elliot suggested that the offering of multiple environmental formats would serve to better meet the needs of most deaf students than does a single format.

The Northridge model. One of the first widely-used models for postsecondary mainstreaming was developed by California State University, Northridge (CSUN) (Jones & Murphy, 1979). The Northridge model of integrated post-secondary education was established in 1964. In this model, students are mainstreamed into regular classes. Support services in the classroom include interpreting, notetaking, and interpreting/notetaking, depending on the needs of the individual students. Notetakers are either volunteers recruited from hearing classmates or paid by deaf support services funding. In the first 12 years of the program's implementation using this model, 95% of the mainstreamed graduating students located employment positions in their area of concentration.

The Northridge model assumes that:

1. The qualified deaf student is best served in the mainstream . . . .

2. Deaf students can successfully compete with hearing peers through the use of support services.

3. Deaf students should have choices from among colleges and universities . . . .

4. Ties with family, friends, and community are best maintained if the deaf student continues his education reasonably close to his place of residence.

5. Opportunities for employment will be greatly enhanced if instructors known to the community endorse the competence of the deaf student . . . . (Jones & Murphy, 1979, pp. 16-17)

The Program for Deaf Adults. In addition to universities, community colleges also develop program models for educating deaf adults. One such example is the Program for Deaf Adults (PDA) at La Guardia Community College in New York, established in 1974 (Khan, 1987). The PDA model, which employs both deaf and hearing staff members fluent in sign language, has the following components:

1. On-going needs assessments are used to determine barriers to participation needing to be removed.

2. Support services, including interpreters and counselors, are part of this model.

3. A diverse offering of courses is made available for deaf students.

4. Teaching techniques geared toward deaf students are developed.

5. The deaf education program is low-cost for the deaf students.

Support Services

Support services for the deaf students, such as interpreters and notetakers, are a crucial part of many of the models described above. One of the most important services in many programs is the interpreter service (Harkins, 1978).

Often deaf students are surveyed to determine which services are the most effective. The evaluation of

support services for the Deaf was studied by surveying 169 graduate and undergraduate deaf students at CSUN (Heffernan, 1979). Of the surveys mailed, 78 (46%) were usable returns. The survey used a five-point Likert scale (1, low satisfaction; 5, high satisfaction) and asked students to rate 19 statements. The statements related to the following services: (a) volunteer notetaking, (b) paid notetaking, (c) notetaking/interpreting, (d) interpreting, (e) counseling, (f) tutoring, and (g) aural rehabilitation. In rating the overall comfort with using the services, the services are listed from highest to lowest rating as follows: (a) aural rehabilitation, (b) interpreting, (c) paid notetakers, (d) tutors, (e) volunteer notetakers, (f) counselors, and (g) notetaker/interpreting. In rating the degree to which support services were perceived as helping the students compete academically, the highest to lowest ranks were reported as follows: (a) aural rehabilitation, (b) interpreting, (c) tutoring, (d) counseling, (e) volunteer notetaking, (f) notetaking/interpreting, and (g) paid notetaking. In evaluating the degree to which support services were considered to help improve or sustain grades, the highest to lowest ranks were cited as follows: (a) aural rehabilitation, (b) tutoring, (c) interpreting, (d) volunteer

notetaking, (e) notetaking/interpreting, (f) paid notetakers, and (g) counseling.

For the purposes of this study, the following summary of a portion of the Heffernan (1979) study is made to clarify the specific importance of those findings to the present investigation. Students rated interpreting higher than notetaking in the following categories: (a) comfort in using the service, (b) degree that service helps academic competition, and (c) degree to which the service helps improve or sustain grades.

Murphy (1976b) conducted another survey at CSUN that studied the effects of interpreter, notetaker, and interpreter plus notetaker services. A total of 24 deaf graduate and undergraduate students with previous experience with an interpreter were used. All notetaker notes used in this experiment were prepared from an audio tape previous to the treatments. This procedure was employed to ensure uniformity of the notes. There were three experimental conditions with each subject viewing three live lectures, each one presented through a different mode. The mode and lecture combinations were different for each of the three groups. In this study, no mention was made of the test utilized to determine the amount of information comprehended for each mode. Interpreting plus notetaking was found to be superior to interpreting alone.

Interpreting plus notetaking was also discovered to produce better results than interpreting alone and notetaking alone (combined means). Interpreting alone was found to be as effective as notetaking alone.

An additional survey was conducted at NTID (Stuckless & Enders, 1971). The purpose of this study was to examine the use of support services by deaf students at NTID. A total of 114 mainstreamed NTID students were given a questionnaire during Fall 1971. Support services examined were interpreting, notetaking, tutoring, and textbooks. When asked how much course content was derived through the interpreter, most of the students claimed to obtain from 50 to 70%. Students receiving As and Bs claimed to have watched the interpreter most of the time. Those with Ds and Fs claimed to have looked at the interpreter seldom or never.

The Effects of Mainstreaming on Deaf and Hearing Students

Attitudes of Hearing Students toward Mainstreamed Settings

Along with the choice of support services, another important consideration is how both the deaf and hearing students are affected by participation in a mainstreamed classroom environment. Though often the effects on deaf students are of major concern, it is important not to overlook the impact that such interactions may have on

hearing students. Studies have been conducted to determine whether hearing students are adversely affected by participation in a mainstreamed environment. One important consideration is whether captioned instructional films and videotapes are distracting to the hearing student.

The effects of captioning on attitudes and comprehension of hearing students were examined using 80 hearing undergraduates in a general education class (Ruggiero, 1986). A 30-minute videotape entitled The New Literacy was used with two treatments: (a) captioned and (b) non-captioned. Audio was used in both cases. Each subject viewed one treatment. A 35-question quiz on the videotape was administered after the viewing. An attitude questionnaire with a Likert-type response format with 16 statements concerning captions and their use in a classroom was also administered as a posttest. No statistically significant differences were found in test performance between groups. Further, there were no significant differences found between the two groups in responses to the attitude questionnaire. These findings may indicate that the presence of captions did not generate a negative attitude from the hearing subjects.

Hearing television audiences were also examined in a similar manner to the above-described study. The

reactions of hearing viewers to open television captions were studied using 229 cable television subscribers (Root, 1970). Questionnaires were mailed to 552 families for completion by all viewers over 12 years old. A total of 229 subjects from 124 families responded, comprising a 24% response rate. Subjects were requested to view two captioned Disney films broadcast locally. For one film, 30% stated that they were bothered by the captions, while 24% had similar feeling for the other film. Only 10% of the subjects stated an objection to the selective open captioning of broadcast television programs.

Other influences of the mainstreamed environment upon the hearing students have also been studied. The effects of hearing college students' association with deaf students were examined using hearing students enrolled with deaf students (n = 195) and those not enrolled with deaf students (n = 92) at California State University Northridge (CSUN)(Carter, 1976). A 30-item questionnaire was completed by all subjects. Areas measured were knowledge of and attitudes toward deafness. The hearing students enrolled with deaf students demonstrated a significantly higher degree of knowledge and a more positive attitude toward deaf students. These subjects were considering the possibility of learning sign language and thought that they would make good supervisors or

co-workers for deaf people in the future. Many sign language interpreters interviewed at CSUN stated that their interest in deafness began while enrolled in classes with deaf students.

Mainstreaming Effects for Hearing and Deaf

One study compared the effects of mainstreaming on both hearing and deaf groups. The effects of a mainstreamed teacher training program were examined by sending questionnaires to deaf and hearing students (n = 52) enrolled in such programs at Gallaudet College (n = 31), San Fernando Valley State College (n = 11), and Western Maryland College (n = 10) (Lunestad, 1971). A total of 52 questionnaires were sent with 34 students responding for a 65% return rate. A majority of the hearing students stated that their communication skills with deaf people improved as a result of this program. Several deaf students thought that they had improved their communication skills with hearing people as well. By the conclusion of training, both groups reported a decrease in the use of pencil and paper to communicate. Most of the hearing students felt that the program helped to increase their comfort level with and understanding of deaf people. Approximately half of the deaf students felt more

comfortable with and understanding of hearing people by the end of the course.

Other studies have focused primarily on the deaf students' experiences. The participation, relationships, and feelings of deaf students in a mainstreamed college classroom were studied, using deaf (n = 8) and hearing students (n = 28) in three mainstreamed Social Work classrooms at the Rochester Institute of Technology (RIT) (Saur, Layne, Hurly, & Opton, 1986). The three categories were defined as follows:

1. Participation was measured by the number of comments and questions elicited by the deaf students in the classroom.

2. Relationships were measured by the degree to which the deaf and hearing groups positively interacted with each other.

3. Feelings were measured by the deaf students' levels of positive perceptions of themselves in their roles as students in the classroom (e.g., how positively they were perceived by the instructor or the hearing students).

Observations and interviews were conducted. In the participation category, it was discovered that the deaf students had difficulty participating in discussions due to the delay time involved in getting information through

the interpreter. This was especially difficult with speakers who spoke rapidly or with discussions that included several speakers. Focusing on the interpreter to get all information resulted in deaf students feeling isolated from the rest of the class. As most deaf students needed to sit in the front of the classroom close to the interpreter, there was further physical isolation.

In the category of relationships, it was determined that deaf and hearing students' relationships depended on the comfort level between individuals in each group. Toward the beginning of the quarter in one class that had a circular seating arrangement, the subjects segregated themselves by sitting in separate groups of deaf and hearing students. This separation disappeared by the end of the quarter. Another difficulty in relationships was that the teacher and hearing students did not know how properly to use the interpreter. The hearing people tended to look at and talk to the interpreter and watch the interpreter while the deaf person was speaking. Most deaf students were willing to work on communication with those hearing students willing to put out effort.

In the feelings category, conditions that contributed to positive feelings on the part of the deaf students were as follows:

1. The deaf students were treated like other students by the instructor. They were not given special treatment nor were they ignored. They were held to the same academic standards as the hearing students.

2. The deaf students who accepted their own hearing loss and the need for support services felt more positive.

3. The deaf students felt better about themselves when they were accepted by the instructor and the hearing students.

Saur, Popp-Stone, and Hurley-Lawrence (1987) decided to further focus on the factors affecting classroom participation of deaf college students in a mainstreamed classroom. They used mainstreamed deaf students (n = 37) at the Rochester Institute of Technology (RIT) and non-mainstreamed deaf students (n = 6) at the National Technical Institute for the Deaf (NTID). A matching number of hearing subjects (n = 37) from the mainstreamed setting and from a non-mainstreamed hearing class (n = 6) were arbitrarily selected for this study. All courses were in either the sciences or liberal arts. A total of nine mainstreamed (either voice only with interpreter or Simultaneous Communication) and two non-mainstreamed classes were involved. Data were obtained through observation and the school records of the subjects.

Participation was measured through a student-teacher interaction checklist. Overall, the hearing students demonstrated more interactions than did the deaf students; although in some individual classes, the deaf interacted more. Hearing students interacted approximately the same amount of times in classes with voice instruction only (with an interpreter) as they did in classes where the instructor lectured with Simultaneous Communication. The deaf students interacted more in the Simultaneous Communication classrooms than they did in the voice only classes. When comparing the separate hearing and deaf non-mainstreamed classes, the deaf students interacted with the teacher more than did the hearing students.

The emotional experience of mainstreaming for deaf students was studied by Foster (1987). Feelings of social isolation were studied through interviews with 25 deaf graduates from NTID. In reflecting on college experiences with hearing students, some of the subjects felt that they had been misunderstood and had difficulty communicating with their hearing peers. The deaf students were often left out of conversations, and found that the hearing students lacked the patience required to communicate properly with deaf people.

Academic Performance in Mainstreamed Settings

In addition to the performance measures mentioned above, the academic performance of the students in a mainstreamed environment is an important measure of the program's success. In comparing the grade point averages of deaf and hearing students at Golden West College in Huntington Beach, California, Culton (1975) determined that there was no difference in academic performance between the two groups.

In a related in-depth study comparing deaf and hearing academic performance was conducted at CSUN (Murphy, 1976a). The differences in academic achievement between deaf and hearing students were studied during 1973 and 1974. The measure of academic achievement used was each student's GPA. GPAs were recorded over two semesters for each deaf student. Random samples of equal size were selected of hearing students' GPA observations by class level through a computer program. Study 1 included 176 deaf and 176 hearing GPA observations (126 undergraduate and 50 graduate). Study 2 included 207 deaf and 207 hearing GPA observations (132 undergraduate and 75 graduate). The grading system was based on a standard A to F assignment of grades using a 0- to 4-point scale, respectively. In Study 1, there were only two significant differences between deaf and hearing students. The

hearing juniors and graduate students outperformed the deaf students in their respective grade levels. The other grade levels showed no significant differences in performance between the two groups. Study 2 revealed no significant differences in GPA between the two groups. Therefore, from this study, it appears that deaf and hearing students produced similar grades in a mainstreamed university environment.

Comparison of Mainstreamed and Non-mainstreamed Environments

One way of determining the effectiveness of a mainstreamed environment is to compare it with a non-mainstreamed setting. Such a study was conducted by Walter and Welsh (1988). The characteristics and successes of deaf college students were examined using deaf subjects (n = 1,644) who were enrolled at RIT and/or NTID during 1976 through 1980. Several categories were examined, including (a) attrition vs. graduation, (b) prior degrees, (c) entering communication skills, and (d) job level and salary after graduation. Three categories of students compared were (a) mainstreamed, (b) students in both mainstreamed and non-mainstreamed classes (mixed), and (c) non-mainstreamed. The entry-level reading and mathematics skills of all subjects were evaluated.

The highest entry-level reading scores belonged to the mainstreamed students. The next highest scores came from the mixed students, followed by the non-mainstreamed students. The differences in mathematics scores were less pronounced. The mainstreamed and mixed students performed slightly better than did the non-mainstreamed group. In examining the attrition versus graduation of deaf students, the mainstreamed students had a higher graduation rate than the mixed students, while the mixed group had more graduates than did the non-mainstreamed group.

Entering communication skills were examined through speech and signing tests. The mainstreamed group held the highest speech skills and the lowest signing skills. The non-mainstreamed demonstrated the lowest speech skills and the highest signing skills. The mixed group held the middle scores for both tests.

To measure post-graduation job level and salary, questionnaires were mailed to the subjects. The mainstreamed group held the highest level jobs, followed by the mixed group and finally the non-mainstreamed group. The mainstreamed and mixed groups' weekly salaries were roughly equivalent, but both received higher salaries than those earned by the non-mainstreamed group.

Typing and Word Processing

Although the focus of this review has been on deafness and mainstreaming, it is important to include information on typing and word processing, as both of these topics play an important role in the present study.

A specific area of interest relates to the quality of work produced by students in typing courses. Ownby (1982) stated that vocational typing programs need to produce quick and accurate typists to fill the major need for skilled typists and word processors in industry.

Accuracy is an important factor in the performance of a typist or word processor. Rauch (1979) mentioned that the acceptable error rate for a 5-minute timed writing is 5 errors (one error per minute).

The importance of accuracy in word processing has been stressed by Rubin (1981). Correcting typographical errors on word processing documents is expensive. When a word processing department is involved, an error-ridden document must be returned for corrections. Several other steps are involved, such as document retrieval from a diskette, the actual error correction, reprinting, and saving the corrected version of the document. In addition, the original writer would need to re-proof the corrected version.

In addition to evaluating accuracy on typed documents, it is important to evaluate the form. A classification system for identifying form errors for typewritten production copy is described by McLean, Kranz, and Magnuson (1980). The authors conducted an analysis of 24 business letters using student samples (n = 2,613). A sample (n = 2,620) of 24 tables was also analyzed. There were 59 error categories for the letters and 43 for the tables. The most common errors on business letters were omitting reference initials and incorrect spacing in the signature block. Common tabular errors included incorrect centering of two-column headings and failure to center the table vertically. A literature search conducted by the author failed to produce any prior classification system.

Summary

In this chapter, literature relating to deafness, mainstreaming, typing, and word processing has been reviewed. The research presented has led to the conclusion that there are insufficient adult education programs for the deaf (Khan, 1987; Larson, 1982; Malone, 1986; Schein et al., 1976). Needs assessments of deaf consumers have revealed that deaf students desire the same types of courses preferred by hearing students (Schein et al., 1976).

In addition to needs assessments, methods and modes of communication in the classroom were examined. Various methods under consideration were direct instructor communication (Berkay, 1990; Caccamise & Blasdell, 1977; Dowaliby et al., 1984), indirect communication through an interpreter (Fleischer & Cottrell, 1976; Murphy & Fleischer, 1976), real-time graphic display (Stinson et al., 1988; Stuckless, 1983), captioning (Dowaliby et al., 1984; Norwood, 1976; Tomasetti et al., 1983), and adaptive devices (Bricault et al., 1985). There appears to be a wide variety of communication methods and modes that have been demonstrated to be effective in the education of deaf adults.

Instructional and program models for the education of deaf adults were also described. Instructional models examined were (a) a model of Direct Instructor Communication in ASL (Berkay, 1990), (b) a mainstreamed typing course model (Rosenberg, 1974), and (c) the Dramatization/discussion model (Tebo, 1984). Program models mentioned were (a) a Range of Options model (Foster & Elliot, 1986), (b) the Northridge model of Integrated Postsecondary Education (Jones & Murphy, 1979), and (c) the Program for Deaf Adults at La Guardia Community College (Khan, 1987). It was noted that there are few models for deaf education available, especially instructional models.

Support services for deaf students in mainstreamed programs were also discussed (Heffernan, 1979; Murphy, 1976b; Stuckless & Enders, 1971). One of the most important services was considered to be interpreting (Harkins, 1978).

The effects of mainstreaming on deaf and hearing students were described. No harmful effects were determined for the hearing students. Root (1970) and Ruggiero (1986) discovered that hearing students were not affected adversely by opened captioned instructional films and videotapes. However, deaf students, at times, were affected adversely by mainstreaming. Sometimes they experienced emotional problems and feelings of social isolation (Foster, 1987). When comparing performance in mainstreamed and non-mainstreamed environments, Walter and Welsh (1988) determined that mainstreamed deaf students performed better than did non-mainstreamed deaf students.

The final section in this chapter addressed typing and word processing concerns. Accuracy was a major focus of this review. Rauch (1979) described the one error-per-minute performance requirement, while Rubin (1981) discussed the importance of accuracy in typing documents. To address the issue of form errors, McLean et al. (1980) presented a classification system for identifying that type of error on a typewritten document.

As previously stated, much of the above-described literature influenced the development of the Direct Instructor Communication in ASL model examined in this study. The need for continuing education for deaf adults, together with the paucity of models and programs for that population, provided justification for the development of a new model designed to meet those needs.

In addition to the consideration of needs assessment, three of the methods and modes of classroom communication and presentation proven effective in the literature were incorporated into the framework of this model as follows:

1. Print was included as a method of presentation through the extensive use of word processing textbooks.

2. Direct communication through the instructor became the model's major component.

3. ASL was chosen as the model's primary sign language form.

Some of the models and programs for deaf adult education described in the literature review influenced this model's development as well. Both of the following concepts provided a rationale for the Direct Instructor Communication model:

1. In the mainstreamed typing course study, both the importance of equal time and attention for the deaf and hearing students was emphasized.

2. The authors of the Dramatization/discussion model suggested that the listeners' focus on an interpreter takes away from making contact with the speaker.

In addition to the review of existing models, support services were also examined. Although interpreting services were demonstrated to be an effective and desirable classroom support for many deaf people, they were not utilized in the Direct Instructor Communication model because the instructor signed directly to the students without assistance from an interpreter. Also, some of the studies examined supported the use of direct instructor communication, as opposed to the use of an interpreter.

Before implementing this model, the effects of mainstreaming on deaf and hearing students were examined. It was a concern that groups of mainstreamed deaf and hearing students may not be comfortable with each other. Studies described in the literature revealed that mainstreamed students from these two groups developed positive attitudes and relationships with one another.

Because the major focus of this study was on a comparison of the performance of deaf and hearing students, other similar comparisons were examined. Two studies revealed that there were no overall differences in grade-point averages between deaf and hearing students in university and community college settings. It was hoped

that a similar result would be found in the adult school environment to which this model was applied.

In addition to examining academic performance, mainstreamed and non-mainstreamed classrooms were also compared. The literature revealed that mainstreamed deaf students obtained higher job levels upon graduation than those in segregated classrooms. Because the Direct Instructor Communication model was based on a vocational curriculum, future employment potential was an important consideration in selecting the mainstreamed environment.

Finally, an examination of typing and word processing literature was found necessary because the original pilot study was conducted using this type of curriculum. The great necessity for accuracy in document production, as expressed in the literature, supported the need for the current study with its measurement of work quality in word processing documents.

CHAPTER 3

METHODS AND STATISTICAL PROCEDURES

This chapter describes the methods used for data analysis and the statistical procedures employed in this study. The information is presented in the following six sections: (a) Definitions of Performance Errors, (b) Performance Criteria, (c) Method, (d) Statistical Procedures, (e) Methodological Assumptions, and (f) Limitations. In the first section, all typographical and formatting errors examined in this study are defined. Examples are also provided. The second section sets forth the criteria used in this study to determine which students have met job-ready standards for an entry-level word processing position. The next part explains the methods used for the selection of the six documents employed for analysis. The following four phases of data analysis used to examine the documents are described and include (a) proofing, (b) spell checking, (c) diskette comparison, and (d) reveal code scan. The fourth section outlines the statistical procedures that were used to compare performance errors and the job-ready status of the two groups of

subjects (deaf and hearing). In the next section a few methodological assumptions that were necessary for this study are explained. In the sixth and final section, limitations of this study are described.

Definitions of Performance Errors

Before selecting documents for analysis, it was necessary to define the errors that would be examined. Performance errors can be broken down into two major categories: (a) formatting errors and (b) typographical errors. The following definitions further break down and explain the types of errors that will be examined in this study. (Note: The number preceding each error corresponds to the error number used for data analysis. In addition, command terms will be capitalized throughout the text.)

Formatting Errors

Formatting errors are those that affect the layout of the document. For the purposes of this study, four categories are defined: (a) substitution errors, (b) omission errors, (c) extraneous errors, and (d) miscellaneous formatting errors.

Substitution Errors

Substitution errors involve the use of incorrect commands or keys in place of the correct ones (e.g., using

spaces in place of Tabs). Substitution errors will be denoted as follows: (a) centering errors, (b) spacing errors, (c) tab errors, and (d) indenting errors.

An example of a substitution Error is CENTER/Tabs. The incorrectly used command or key appears in all capital letters (e.g., CENTER). The correct command or key that should have been used appears in mixed case (e.g., Tabs).

The above example indicates that a Center command was incorrectly used in place of Tabs.

The following sections provide definitions and examples of the substitution errors examined in this study.

Centering errors

1. CENTER/Tabs. Centering refers to the act of arranging either headings or text on a page such that the targeted text is positioned with an equal amount of margin to the left and right of the text. Errors occur when a Center command is used incorrectly in place of Tabs for the date, Complimentary Closing (e.g., Sincerely), and/or the writer's name. In Modified Block letter style, these items should start at the center of the page (by using Tabs). They should not be centered.

An incorrect example is as follows:

Sincerely,

Paul James Berkay

A correct example is as follows:

Sincerely,

Paul James Berkay

Spacing errors

Spacing refers to the placement of blank spaces between letters and words in text. There should be one space between words and two spaces between sentences. The following substitution errors are related to spacing:

2. SPACES/Tabs. Spaces are incorrectly used in place of Tabs. These errors are commonly made at the beginning of a paragraph when a student cannot figure out how to use the Tab key. (Note: When an example is not provided, this means that the error could only be detected by looking at the Reveal Code screen. It would not be evident when looking at a printed document.)

3. SPACES/Indent. Spaces are incorrectly used instead of an Indent command (temporary left margin).

This mistake is commonly made at the beginning of indented enumerated paragraphs. This error may not show up on a document, but can be detected by looking in the Reveal Code screen. The student would have to use spaces on every line of the indented paragraph in order to make it appear as if the text had a temporary left margin. This practice makes editing impossible. If one word is changed in the paragraph, every line may have to be retyped.

Tab errors

Tabs refer to the commands that create a preset number of spaces on the document. For example, it is more practical to move to a preset five-space Tab at the beginning of paragraph than to move the space bar five times. The following four categories of errors are related to Tabs:

4. TAB/Indent. Tab commands are incorrectly used in place of Indent commands. This error is commonly made at the beginning of enumerated indented paragraphs. When this error is performed, only the first line of the paragraph is indented. The continuation of the text within the paragraph resumes at the left margin, rather than at the temporary left margin created to produce a blocked effect.

An incorrect example is as follows:

A. This paragraph should have a temporary left margin. Since the Tab command was used in error, the second line returned to the left margin.

A correct example is as follows:

A. This paragraph was created with an Indent command after the period. Notice that all lines of text are lined up at the temporary left margin.

---

5. TAB/Spaces. Tab commands are incorrectly used in place of spaces. Generally, this error occurs between sentences following a period.

Indenting errors

Indenting refers to the establishment of a temporary left margin for special text or enumerations within a document. The indent command eliminates the necessity to use a Hard Return and a Tab at every line of text to be indented. The following errors relate to indenting:

6. INDENT/Double Indent. The Indent command is incorrectly used in place of the Double Indent command. This error is commonly made with stand-alone quotes that should be indented equally on both sides. The student may be confused about the difference between the two or may

have failed to hold down the shift key while pressing F4. This error results in the right side of the quote incorrectly lining up at the left margin.

An incorrect example is as follows:

The following text is a quote and should be indented on both sides (double indented):

Since a single indent was used in error, the text is indented only on the left side. The right margin will line up with the right margin of the non-quoted text.

A correct example is as follows:

The following text is a quote and is indented on both sides (double indented):

Since a double indent was used correctly, the text is indented on both the left and right sides. The right margin will be indented equally with the left margin.

---

7. INDENT/Tab. The Indent command is improperly used in place of a Tab. Invoking the Indent command would result in the formation of a temporary left margin. In order to compensate for this error, the student would use

a Hard Return at the end of the line in order to make the text return back to the left margin.

Omission Errors

Omission errors are made when a command or key is not used as required. Unlike substitution errors, incorrect commands or keys are not used in place of the proper ones. Omission errors identified in this study are described as follows: (a) Incomplete Documents, (b) Omitted Tabs, (c) Omitted Hard Returns, and (d) Miscellaneous Omitted Commands.

8. Incomplete Documents. In several instances, an exercise in the WordPerfect textbook presents new text to be added to an existing document. Some students misunderstand the task and type only the new text, rather than retrieving the old document and adding the new text to the bottom of the old text. This occurrence results in documents that include only a portion of the complete text.

9. Omitted Tabs. Tabs are not entered in the proper place. Nothing is entered in place of them. Tabs are required to begin the date and signature block at the center of the page in a Modified Block format, such as the one used in the textbook. Failure to do this will leave the date and complimentary closing at the left margin. Missing Tabs at the beginnings of paragraphs (as required

in some document formats) will result in the text on the first line beginning at the left margin.

10. Omitted Hard Returns. Hard Returns are not entered when required. Nothing is entered in their place. These omissions occur in several places. Examples are (a) in the signature block, (b) between paragraphs, (c) between the subject and the body of the letter, and (d) between the date and the address. Omitting returns can result in the document not conforming to an acceptable format.

11. Miscellaneous Omitted Commands. This category covers all omitted commands not previously mentioned.

Extraneous Errors

Extraneous errors are made when a command or key is used when not required. Unlike substitution errors, these incorrect commands are not used in place of correct ones. Extraneous errors examined in this study are described as (a) Command Used in Error, (b) Extraneous Hard Returns Miscellaneous), (c) Extraneous Hard Returns (In Place of Wordwrap), (d) Extraneous Tabs, and (e) Extraneous Indents.

12. Command Used in Error (Affects Text). Some commands used in error affect text. An example would be the use of a Double Space command in the middle of the document. This could change all subsequent text to double

spacing. Some misused commands do not affect the text. An example is the use of a Double Space command at the end of the document after all text. In this case, no text would be affected. For the purposes of this study, only those misused commands that affect text were examined.

13. Extraneous Hard Returns (Miscellaneous). Extraneous Hard Returns are those that appear in the text when not required. An example is an extra return in the signature block. Additional Hard Returns could result in violations of standard document format rules.

14. Extraneous Hard Returns (In Place of Wordwrap). In WordPerfect, students do not need to return at the end of a line in the middle of a paragraph. The program automatically determines when to end the line and start a new one. A Soft Return is then created. Those students accustomed to hitting the carriage return at the end of each line on a typewriter have difficulty using this feature. Hard Returns at the ends of lines in paragraphs can result in future editing problems with the document.

15. Extraneous Tabs. Tabs are used when not required. A common occurrence of this error is in the signature block. Extra Tabs are placed before the complimentary closing and the name causing the entire block to begin right of the center, rather than at the center of the page.

16. Extraneous Indents (Single or Double). Extraneous Indents are those placed in the document when not required. This often happens when the student does not allow Wordwrap to return at the end of each line in a paragraph with a temporary left margin. To adjust for this problem, the student often puts an Indent in front of each line in the paragraph.

Miscellaneous Formatting Errors

17. Miscellaneous Formatting Errors. Miscellaneous formatting errors are formatting errors that do not involve the incorrect substitution, omission, or extraneous use of commands or keys. These errors are varied. In some cases, students forget to clear the screen before retrieving a new document. The file is then saved with more than one document or several copies of the same document. Another common error is putting a Command after the text that should be affected. Commands must be placed before the text that is to be affected. For example, a Double Space command after the text to be affected will not double space the text as it should. It will only double space text that follows. Another common error results when students do not Block and Delete extra text in a document. Often the textbook requires that a previously typed paragraph be deleted. Some students do not

follow directions and these unwanted paragraphs appear on the final document.

Typographical Errors

Typographical errors are those occurring in the actual text and not the page format. Typographical errors examined in this study include (a) text errors, (b) punctuation errors, and (c) spacing errors. Each type of error is defined in the following section.

Text Errors

18. Misspelled Word. Students misspell words in these documents, despite the fact that the correct spellings are presented in the book. This is a careless error, rather than one caused by lack of spelling ability. Students rushing to complete work often do not check for or correct spelling errors. Each misspelled word counts as one error, regardless of how many mistakes appear in that word. It should be noted that WordPerfect's spelling feature is not normally used for the documents examined in this study. This feature is introduced in Chapter 15, while the curriculum for the course employed in this study did not go beyond those exercises contained in Chapter 12. Some students occasionally discovered this feature and used it on their own.

19. Omitted Words. Words appearing in the exercise are omitted by the student.

20. Wrong Word. Occasionally the student will type an incorrect word in the place of a correct one. For example, the textbook might read "employee," and the student types "employment."

21. Word not Capitalized. Some words that should be capitalized are left uncapitalized by the student. For example "new york" might be typed in place of "New York."

22. Wrong Case. In some of the textbook exercises, some words should be typed with all uppercase letters. Some students use lower case instead. The reverse also occurs. For example, the book reads "DOCUMENT," and the student types "document" or "Document."

23. Miscellaneous Text Errors. This category includes text errors not mentioned above. Some examples are (a) using extraneous words, (b) splitting one word up into two words, (c) incorrectly capitalizing words, (d) using incorrect symbols (e.g., the ampersand [&] for "and"), and (e) misnumbering enumerated items. An example of the last error would be to have items numbered 1, 2, and 4, skipping Number 3.

Punctuation Errors

24. Punctuation Errors. Punctuation is either substituted, omitted, or extraneous. For example, a period

is missing at the end of a sentence. Another example is the use of an exclamation point in place of a period.

Spacing Errors

25. Sentence Spacing Omission Errors. Two spaces are required after a period, question mark, or exclamation mark. Often students are not familiar with this rule and include only one space between sentences.

26. Extraneous Spacing. Some students carelessly add extra spaces in text. This often occurs when the space bar is struck in error.

27. State/Zip Code Spacing Error. Two spaces should always appear between the state abbreviation and the Zip Code on an address appearing on a letter. Students often put one space or three or more, due to unfamiliarity with this rule or carelessness.

28. Miscellaneous Spacing Omission Errors. The category includes spacing omission errors not previously mentioned. Some examples are (a) failing to space between words, (b) failing to space after a comma, and (c) leaving only one space, rather than two, following a colon.

Performance Criteria

It was also necessary to establish performance criteria to determine whether the students' work met job-ready quality standards for an entry-level word processing

position. The following standards were established for this comparison:

1. No more than five formatting errors were allowed per document.

2. No more than five typographical errors were allowed per document.

3. No more than eight total errors (both formatting and typographical) were allowed per document.

It would be determined whether one or both groups (deaf and/or hearing), as well as individual subjects, met job-ready quality standards in the production of documents included in the exercises analyzed.

Method

Protection of Human Subjects

Since only archival data that was the property of the author would be used for this study, no approval was obtained from the University Research Office through the standard protocol form. Further, the students who had participated in the class were no longer accessible. All references to specific individuals were omitted from this study. Their classification as deaf or hearing and their gender were the only personal-related data retained.

Subjects

Eleven newly enrolled deaf and hard-of-hearing (deaf)(5 male and 6 female) and 11 newly enrolled hearing students (hearing)(2 male and 9 female) from the author's Winter 1989 WordPerfect adult school class had their diskettes examined in this study. All subjects were enrolled in this course for the first time. The ages of the subjects are unknown. All of the deaf and hard-of-hearing subjects were skilled communicators in ASL and received lectures and other class-related information, usually presented verbally, through signed communication from the instructor.

Instrumentation

The six documents analyzed in this study appear in WordPerfect: Tutorial & Applications by Mary Alice Eisch (1988). The text was designed for WordPerfect, Version 4.1/4.2. All documents were typed on Version 4.2.

Data Analysis

Document Selection

Hearing (n = 12) and deaf (n = 11) students' diskettes from the Winter 1989 WordPerfect course were copied from 23 individual 5 1/4" diskettes to one high density 3 1/2" diskette. Two directories were created: DEAF and NEW-HEAR (new hearing--this classification heading was

retained from the original study, in which some hearing students who were enrolled in the course under investigation had taken a previous word processing course with the author and had been designated as "old hearing"). Each directory was assigned subdirectories, each named for one of the 23 subjects. The content of this 3 1/2" diskette was copied onto another 3 1/2" diskette. The copy was examined using WordPerfect 5.1.

Each file for each student was reviewed in the Look mode on the List File screen. Several of the students had misnamed their files. The file names were changed to names assigned by the textbook. This was done with the Move/Rename command. Files not belonging to the textbook, such as personal student files, were deleted. Sometimes a student had more than one version of a textbook document under different file names. At other times, they would save the document once under the correct name and one or more times using a different file name. When this practice was discovered, the duplicate files were kept and renamed with different extensions (e.g., the second version of DOCUMENT.1 would be DOCUMENT.1A). It was necessary to keep all copies because it was difficult to determine at the time of this initial review procedure which file represented the best copy that the student had turned in for the assigned task. When the file

alterations were finished with this diskette, the final product contained all student files pertaining to the textbook with their correct file names.

This altered version of the last diskette was copied onto another 3 1/2" diskette. The List File screen for each student was printed using the <Shift><Print Screen> function on the keyboard. This resulted in a directory of document files for each student.

A list was made of all documents that at least one student had completed from either group. Although there were approximately 57 exercises in the 24-chapter textbook, no student in this 14-week (42-hour) course worked past Exercise 34 at the end of Chapter 15.

After the student directories were viewed, the number of deaf and new hearing students who had completed each document was noted next to the document file name on the list. This information is provided in Table 1.

Six exercises were selected as a representative sample of the 34. The following five criteria were used to select the representative exercises:

1. Exercises were chosen that were completed by as many of the subjects as possible.

2. Exercises were selected that were completed by an equal (or nearly equal) number of deaf and hearing students.

Table 1

List of Documents Completed by Hearing (n = 11) and Deaf (n = 11) Students

Exercise no.	n	
	Hearing	Deaf
1	11	9
2	6	6
3	4	2
4	9	7
5	6	9
6	9	10
7	8	9
8	8	8
9	7	5
10	8	6
11	7	7
12	6	5
13	6	5
14	6	5
15	6	6
16	5	3
17	4	4
18	4	4
19	4	4
20	4	4
21	5	3
22	4	2
23	4	1
24	5	2
25	4	2
26	4	2
27	3	1
28	3	1
29	3	2
30	3	1
31	3	2
32	3	1
33	1	1
34	4	0

3. Most of the selected exercises represented a level of complexity that could result in several errors if improperly typed.

4. The selected exercises represented as great a span of chapters as possible.

5. Exercises that contained revisions of documents typed in previous exercises were avoided. This criterion minimized the risk of confusing the different versions and the respective exercises to which the multiple versions belonged.

The list of six exercises chosen for analysis, including document names, is included as Table 2.

The most recent 3 1/2" diskette with the complete and corrected files of the students was again altered. This time, all but the six final documents (and their duplicate versions) were deleted from each student's directory. In the course of condensing the student directories to include only the six documents, it was discovered that one of the hearing students had not completed any of the six final documents. This subject's directory and documents were eliminated from this disk and from the analysis. This created an even number of subjects in each group (n = 11).

Table 2

List of Six Documents Selected for Data Analysis and the Number of Hearing (n = 11) and Deaf (n = 11) Students Completing Each

		n	
Exercise no.	Doc name	Hearing	Deaf
1	MEMO2.A	11	9
6	MEMO6.2	9	10
8	JOB7EX1	8	8
11	SECURE8.1	7	7
15	EXER11.1	6	6
19	JOB12.1	4	4

This 3 1/2" diskette with the final documents was copied onto two 5 1/4" diskettes, each receiving copies of the files from one of the main directories (DEAF and NEW-HEAR).

Hard copies of all students' directories with the final documents were made by printing from the List File screen. At this point, WordPerfect Version 4.2 was used to print all of the final documents for all students. Although Version 5.1 would have been more efficient to use, there was some concern that the documents might become altered while being converted from 4.2 to 5.1.

A set of directories and copies of the final documents was duplicated in preparation for the analysis of errors. In addition, a chart was prepared that showed each subject and which of the six documents each one completed (see Table 3). Four subjects from each group (deaf and hearing) had completed all six final documents. Five deaf and six hearing subjects each completed the first five documents.

Analysis

In order to perform a thorough analysis of all of the documents, four phases were implemented as follows: (a) proofing, (b) spell checking, (c) diskette comparison, and (d) reveal code scan. The results of these four phases are described in the following paragraphs:

Table 3

Documents Completed by Subject

Subject number	Document 1	2	3	4	5	6	Total docs
			Hearing students (n = 11)				
1	X	X	X	X	X	X	6
2	X	X	X	X	X		5
3	X	X	X	X			4
4	X						1
5	X	X	X	X	X		5
6	X						1
7	X	X	X	X	X	X	6
8	X	X					2
9	X	X	X				3
10	X	X	X	X	X	X	6
11	X	X	X	X	X	X	6
Total	11	9	8	7	6	4	45
			Deaf students (n = 11)				
12		X					1
13	X	X	X	X	X	X	6
14	X	X	X	X	X	X	6
15	X	X	X	X			4
16	X	X	X				3
17	X	X		X			3
18	X	X	X	X	X	X	6
19	X	X	X	X	X		5
20	X	X	X	X	X	X	6
21	X	X	X				3
22					X		1
Total	9	10	8	7	6	4	44
Grand total	20	19	16	14	12	8	89

Note. X = Document completed.

Phase 1--Proofing. The first phase involved the proofreading of each document with a comparison to the original in the student workbook and the teacher's key. The following describes the procedure that was followed:

1. The researcher first read the exercise instructions in the student workbook for understanding of expectations of the finished documents.

2. The teacher's key was compared to the student workbook for discrepancies. The student workbook would be considered the correct source, since it contained the material presented to the students. Two discrepancies were discovered and noted in the teacher's key.

3. It was decided that all documents with the same file name would be read together for all students. This was preferable to reading each subject's separate documents together. Repeating readings of the same document improved the familiarity with the text, and could have reduced the possibility of failing to catch errors.

4. Each document was then read to check for formatting and typographical errors. A detected error was circled in red pencil, and notation of the type of error made was included next to the circle.

5. Notation was made at the bottom of a document when items needed to be checked later on the reveal code screen for detection of possible errors not visible on the

printed document. For example, if it was uncertain whether Right Justification had been turned off, a note was written stating, "Check for Right Justification Off."

6. If missing text was detected, the document was checked against the teacher's key and student workbook. A note was written to indicate missing words (e.g., "9 words missing").

7. It should be noted that in Phase 1 (Proofing), it was possible that errors involving missing words might have gone undetected. This circumstance is especially true if the missing text did not interfere with the clarity and understanding of the document.

Phase 2--Spell Checking. The second phase involved running each document through the WordPerfect Spell Check feature. Spelling errors not previously detected in Phase I were circled on the documents. It should be noted that properly spelled words incorrectly used would not have been detected in Phase 2.

Phase 3--Comparison. The next phase involved the use of WordPerfect's Disk Comparison feature. It was utilized to compare all student documents with a correct original. The purpose of this phase was to locate omitted and extraneous text that was missed in Phase 1. When reading a document, it is possible to miss such text errors that do

not hinder coherency. For example, the original document could read, "I gave a copy to all of the students." The student document might read, "I gave a copy to all students." The sentence still makes sense without the two missing words "of the." Such errors may be missed by a reader, but picked up by the Document Comparison feature. The procedure can be described as follows:

1. A perfect original for each of the six documents was created by the researcher. It was carefully compared to the teacher's key. As an extra check, the researcher tape recorded the text of each document and then listened to the tape while proofing the perfect originals. In order to make the file names different from the student file names, a "z" was added at the end of the extension of each perfect original (e.g., DOC1.A became DOC1.AZ).

2. WordPerfect's Disk Comparison command was used to compare the perfect original to each student document. The student document was first retrieved on WordPerfect Version 5.1. A spell check was done to correct the previously detected spelling errors. All previously detected formatting and typographical errors were also corrected. As this phase was designed to pick up all previously undetected errors, the previously detected ones needed to be corrected so that they would not clutter up the screen.

3. Once the document was cleaned up, the Document Comparison command was executed. Redlining and strikeout then appeared on the screen to show where the two versions of the document (the perfect original and the student's) differed. The redline represented text appearing on the student document, but not on the original. The strikeout represented text appearing on the original, but not on the student document. Redline/strikeout does not pick out individual errors. Instead sections containing individual errors are highlighted. The end of a section is determined by punctuation or a Hard Return. This makes it difficult to find individual errors in long sections that are highlighted.

4. When a section appeared with redline/strikeout, an attempt was made to discover the error by comparing text from both documents on the screen and/or the Reveal Code screen.

5. There was a concern that some long, complicated sections with redline/strikeout could contain more than one error, and errors might also be harder to detect. In order to prevent some errors in such a section to go undetected, the following process was followed:

a. An attempt would be made to discover one error in a large section by looking at text from both versions.

b. When one error was found, the redline/strikeout would be removed from the entire document.

c. Then the one error discovered would be corrected on the student's document.

d. The Document Comparison command would be executed again.

e. If the previously viewed section no longer contained redline/strikeout, then that section was finished, and the one error was noted in red pencil on the copy previously corrected during Phases 1 and 2.

f. If the section still contained redline/strikeout after the first error was detected, then Steps a through e were repeated until the section was free of redline/strikeout.

All newly detected errors were noted in red pencil on the previously proofed copies.

Phase 4--Reveal Code Scan. The fourth phase involved the examination of each document through WordPerfect's Reveal Code screen. The procedure was as follows:

1. Each document was pulled up on the WordPerfect Version 4.2 Reveal Code screen. All codes appearing on that screen were examined to detect formatting errors.

2. The purpose of this final phase was to detect code-related formatting errors that would not show up on a printed document. Such errors may not affect the

appearance of a printed document, but could hinder future editing. A good example is when the student uses all spaces instead of tabs on enumerated items. A printed document would appear correct, but the Tabs would not appear on the Reveal Code screen.

3. Errors detected in this phase were noted on the copies proofed in the first three phases.

Statistical Procedures

An alpha level of .05 was used for each statistical test conducted in this study. All statistics were performed on SPSS: Statistical Package for the Social Sciences (Nie, Hull, Jenkins, Steinbrenner, & Bent, 1975). The statistical procedures employed for each of the four hypotheses are set forth in the sections immediately following this paragraph.

Hypothesis 1

To test the hypothesis that deaf students will perform more errors than hearing students, the following statistical tests comparing work quality were conducted:

1. For each of the six documents, the number of formatting, typographical, and total errors made by each group (deaf and hearing) was determined. A Mann-Whitney U test was conducted on each document by formatting, typographical, and total errors for group comparison. A total

of 18 Mann-Whitney U tests was required for these analyses. In addition, the group mean errors from all six documents were averaged together to determine total document group mean scores for formatting, typographical, and total errors. A Mann-Whitney U test was also conducted on the these total document averages for group comparison. A total of three Mann-Whitney U tests was employed for this analysis.

2. For each of the six documents, the number of errors in each of the 28 error categories made by each group (deaf and hearing) was determined. (The categories correspond to the detailed breakdown of errors classified in the Definitions of Performance Errors section.) A Mann-Whitney U test was conducted on each document by each error category for group comparison. As in the previous section, total document averages from all six documents were obtained for each error and subjected to a Mann-Whitney U test for group comparison. A total of 28 Mann-Whitney U tests was performed for this analysis.

Hypothesis 2

To test the hypothesis that more than half of the students in each group would not meet job-ready standards, the following statistical tests were conducted:

1. The formatting, typographical, and total errors for each subject were counted. Each student's document

scores were averaged. Each average score was then compared to the job-ready standard score (5 formatting or 5 typographical errors and 8 total errors) to determine whether the individual student had met job-ready standards. Each student was assigned either a yes or no status. A simple inspection of the number of deaf and hearing students was made.

Hypothesis 3

In order to test the hypothesis that more deaf students than hearing students would not meet job-ready standards, chi square tests of independence were used to determine whether the number of subjects meeting standards from one group was equal to or different from the number of subjects meeting the standards from the other group for formatting, typographical, and total errors.

Hypothesis 4

To test the hypothesis that neither group would collectively meet job-ready standards, the six-document overall averages were obtained for formatting, typographical, and overall errors (from the test conducted as mentioned in Hypothesis 1 above). A z-ratio was used to compare each group's averages with the job-ready standards to determine if that group collectively met the standards.

Methodological Assumptions

The following methodological assumptions were necessary for the purposes of this study:

1. Performance in a word processing classroom is a valid predictor of job performance and stability in an entry-level word processing position.

2. Students behaved honestly in class. It was assumed that these adults were motivated to enhance job skills and not under pressure of grades. Further, it was assumed that students did not copy the documents of others or otherwise cheat in class.

Limitations of the Study

There were some limiting factors in this study that occurred for various reasons. Some were due to the summative nature of the study that examined data from a prior course not set up for experimental research. Others were factors beyond the control of the author. The following limitations should be noted:

1. The small sample sizes for each group (n = 11) limits the ability to generalize to populations of either hearing students or deaf students enrolled in word processing courses. The small sample size led to the decision to use nonparametric statistics to support the data analyses.

2. Another limitation is that during the Winter 1989 course, students were not asked to strive for a specific standard of work quality. They were not assigned grades or instructed to stay within an acceptable margin of errors. Typographical errors were not addressed by the instructor. Such factors may have affected the motivation to perform up to an acceptable standard of quality.

3. The course itself was not designed to produce job-ready students. This circumstance could have further affected the ability to generalize the results from this course to predict performance in a job-ready oriented course.

4. Another limitation is that the subjects in the hearing group (2 males and 9 females) were not evenly distributed by gender. The ages of all subjects are unknown. These factors could further limit the ability to generalize the results from this study to a normal population.

5. One further limitation is that improvement from the beginning to the end of the course could not be analyzed due to the variation in the complexity and length of documents used in this course. For example, Document 1 was a paragraph, while Document 15 (the fifth document) was an entire page with several paragraphs.

CHAPTER 4

RESULTS AND INTERPRETATION

In this chapter, the results, statistical analyses, and interpretation of data are provided. Presentation of data will be according to the order of the hypotheses introduced in Chapter 1.

Hypothesis 1

In the first hypothesis, an attempt was made to determine if there was a significant difference in the quantity of errors on word processing documents keyed by deaf and hearing students. A Mann-Whitney U test was used to compare total formatting errors, total typographical errors, and total errors for each of the six documents. In addition, the 28 individual errors (previously described in Chapter 3) were also compared. Tables 4 through 9 (representing Documents 1 through 6) show the obtained means, standard deviations (SD), Mann-Whitney U scores, and *z* scores for the comparison of the two groups (deaf and hearing) on the 28 individual errors, total formatting, total typographical, and total errors.

Table 4

Word Processing Errors by Group--Document One: Hearing (n = 11) and Deaf (n = 9)

Error no.	Error type	Hear mean	Hear SD	Deaf mean	Deaf SD	Mann-Wh U	z score
E1	SB	--	--	--	--	--	--
E2	SB	--	--	--	--	--	--
E3	SB	--	--	--	--	--	--
E4	SB	--	--	--	--	--	--
E5	SB	--	--	--	--	--	--
E6	SB	--	--	--	--	--	--
E7	SB	--	--	--	--	--	--
E8	OM	--	--	--	--	--	--
E9	OM	--	--	--	--	--	--
E10	OM	--	--	--	--	--	--
E11	OM	--	--	--	--	--	--
E12	EX	--	--	--	--	--	--
E13	EX	--	--	0.11	0.33	44.0	-1.11
E14	EX	--	--	0.89	1.76	38.5	-1.61
E15	EX	--	--	--	--	--	--
E16	EX	--	--	--	--	--	--
E17	MF	0.09	0.30	--	--	45.0	-0.90
E18	TX	0.09	0.30	0.44	1.01	42.5	-0.86
E19	TX	--	--	0.11	0.33	44.0	-1.11
E20	TX	0.09	0.30	0.56	0.73	31.5	-1.81
E21	TX	--	--	--	--	--	--
E22	TX	--	--	--	--	--	--
E23	TX	--	--	--	--	--	--
E24	PN	--	--	--	--	--	--
E25	SP	0.36	0.51	0.33	0.50	48.0	-0.14
E26	SP	--	--	--	--	--	--
E27	SP	--	--	--	--	--	--
E28	SP	0.18	0.41	0.11	0.33	46.0	-0.43
FTOT		0.09	0.30	1.00	2.00	42.0	-0.92
TTOT		0.73	1.10	1.56	1.81	33.0	-1.33
TOTAL		0.82	1.08	2.56	2.46	28.0	-1.70

Note. EX = Extraneous Errors, FTOT = Total Formatting Errors, MF = Miscellaneous Formatting Errors, OM = Omission Errors, PN = Punctuation Errors, SB = Substitution Errors, SP = Spacing Errors, TOTAL = Total Errors, TTOT = Total Typographical Errors, TX = Text Errors. A dash (--) indicates no data because the group made no errors in that category.

Table 5

Word Processing Errors by Group--Document Two: Hearing (n = 9) and Deaf (n = 10)

Error no.	Error type	Hear mean	Hear SD	Deaf mean	Deaf SD	Mann-Wh U	z score
E1	SB	--	--	--	--	--	--
E2	SB	--	--	--	--	--	--
E3	SB	--	--	--	--	--	--
E4	SB	--	--	--	--	--	--
E5	SB	0.22	0.67	--	--	40.0	-1.05
E6	SB	--	--	--	--	--	--
E7	SB	--	--	--	--	--	--
E8	OM	--	--	0.20	0.42	36.0	-1.38
E9	OM	--	--	--	--	--	--
E10	OM	0.56	0.53	0.20	0.42	29.0	-1.56
E11	OM	--	--	--	--	--	--
E12	EX	--	--	--	--	--	--
E13	EX	0.11	0.33	0.40	0.52	32.0	-1.39
E14	EX	0.11	0.33	0.10	0.32	44.5	-0.08
E15	EX	--	--	--	--	--	--
E16	EX	--	--	--	--	--	--
E17	MF	0.33	0.71	0.30	0.48	43.0	-0.21
E18	TX	1.33	1.66	1.40	1.35	41.5	-0.30
E19	TX	0.67	0.87	0.30	0.48	35.5	-0.91
E20	TX	0.67	1.00	0.50	0.71	42.5	-0.23
E21	TX	0.22	0.44	0.10	0.32	39.5	-0.71
E22	TX	0.44	1.33	1.10	1.79	37.0	-0.92
E23	TX	--	--	0.10	0.32	40.5	-0.95
E24	PN	0.56	0.73	0.20	0.42	33.0	-1.20
E25	SP	0.56	1.33	0.30	0.68	43.5	-0.17
E26	SP	0.44	0.73	0.90	1.37	39.0	-0.57
E27	SP	--	--	--	--	--	--
E28	SP	0.33	0.71	0.20	0.42	43.0	-0.23
FTOT		1.33	1.32	1.20	1.14	44.5	-0.05
TTOT		5.22	5.22	5.10	4.38	41.5	-0.29
TOTAL		6.56	5.88	6.30	3.97	43.5	-0.12

Note. EX = Extraneous Errors, FTOT = Total Formatting Errors, MF = Miscellaneous Formatting Errors, OM = Omission Errors, PN = Punctuation Errors, SB = Substitution Errors, SP = Spacing Errors, TOTAL = Total Errors, TTOT = Total Typographical Errors, TX = Text Errors. A dash (--) indicates no data because the group made no errors in that category.

Table 6

Word Processing Errors by Group--Document Three: Hearing (n = 8) and Deaf (n = 8)

Error no.	Error type	Hear mean	Hear SD	Deaf mean	Deaf SD	Mann-Wh U	z score
E1	SB	--	--	--	--	--	--
E2	SB	--	--	--	--	--	--
E3	SB	--	--	--	--	--	--
E4	SB	--	--	--	--	--	--
E5	SB	0.25	0.71	0.13	0.35	31.5	-0.91
E6	SB	--	--	--	--	--	--
E7	SB	--	--	--	--	--	--
E8	OM	--	--	--	--	--	--
E9	OM	--	--	--	--	--	--
E10	OM	--	--	--	--	--	--
E11	OM	--	--	0.25	0.71	28.0	-1.00
E12	EX	--	--	0.25	0.71	28.0	-1.00
E13	EX	0.13	0.35	0.13	0.35	32.0	0.00
E14	EX	0.13	0.35	--	--	28.0	-1.00
E15	EX	--	--	--	--	--	--
E16	EX	--	--	--	--	--	--
E17	MF	0.13	0.35	--	--	28.0	-1.00
E18	TX	1.00	1.41	1.00	1.31	30.5	-0.17
E19	TX	0.50	0.56	0.13	0.35	20.0	-1.57
E20	TX	--	--	0.25	0.46	24.0	-1.46
E21	TX	0.37	1.06	0.13	0.35	31.5	-0.91
E22	TX	0.38	0.74	0.38	0.74	32.0	0.00
E23	TX	0.38	0.74	--	--	24.0	-1.46
E24	PN	--	--	--	--	--	--
E25	SP	0.38	1.06	--	--	28.0	-1.00
E26	SP	0.38	1.06	0.38	0.74	29.0	-0.46
E27	SP	--	--	--	--	--	--
E28	SP	--	--	0.13	0.35	28.0	-1.00
FTOT		0.63	0.92	0.75	1.39	31.5	-0.06
TTOT		3.38	4.24	2.38	2.00	31.5	-0.05
TOTAL		4.00	3.96	3.13	2.10	32.0	0.00

Note. EX = Extraneous Errors, FTOT = Total Formatting Errors, MF = Miscellaneous Formatting Errors, OM = Omission Errors, PN = Punctuation Errors, SB = Substitution Errors, SP = Spacing Errors, TOTAL = Total Errors, TTOT = Total Typographical Errors, TX = Text Errors. A dash (--) indicates no data because the group made no errors in that category.

Table 7

Word Processing Errors by Group--Document Four: Hearing (n = 7) and Deaf (n = 7)

Error no.	Error type	Hear mean	Hear SD	Deaf mean	Deaf SD	Mann-Wh U	z score
E1	SB	0.57	0.98	0.86	0.90	19.5	-0.72
E2	SB	0.14	0.38	0.14	0.38	24.5	0.00
E3	SB	--	--	--	--	--	--
E4	SB	--	--	0.29	0.49	17.5	-1.47
E5	SB	--	--	0.43	1.13	21.0	-1.00
E6	SB	--	--	0.14	0.38	21.0	-1.00
E7	SB	0.29	0.76	0.29	0.76	24.5	0.00
E8	OM	--	--	--	--	--	--
E9	OM	0.43	0.79	--	--	17.5	-1.47
E10	OM	0.14	0.38	0.57	0.79	17.0	-1.21
E11	OM	--	--	--	--	--	--
E12	EX	--	--	--	--	--	--
E13	EX	0.57	0.79	0.86	1.22	22.5	-0.28
E14	EX	0.86	1.86	1.00	1.41	21.5	-0.45
E15	EX	0.14	0.38	0.43	1.13	24.0	-0.10
E16	EX	0.57	1.51	0.29	0.49	22.0	-0.45
E17	MF	--	--	0.14	0.38	21.0	-1.00
E18	TX	1.29	1.60	1.00	1.16	23.0	-0.20
E19	TX	0.29	0.49	0.86	0.69	13.0	-1.64
E20	TX	0.43	0.54	0.57	0.98	24.0	-0.08
E21	TX	--	--	--	--	--	--
E22	TX	--	--	--	--	--	--
E23	TX	0.14	0.38	--	--	21.0	-1.00
E24	PN	0.43	0.54	0.43	0.54	24.5	0.00
E25	SP	0.57	1.13	--	--	17.5	-1.47
E26	SP	0.14	0.38	1.29	2.14	13.5	-1.66
E27	SP	0.57	0.54	0.14	0.38	14.0	-1.61
E28	SP	0.42	0.54	--	--	14.0	-1.88
FTOT		3.71	4.89	5.42	3.60	15.0	-1.22
TTOT		4.29	3.73	4.29	2.98	22.0	-0.32
TOTAL		8.00	7.94	9.71	3.90	17.5	-0.90

Note. EX = Extraneous Errors, FTOT = Total Formatting Errors, MF = Miscellaneous Formatting Errors, OM = Omission Errors, PN = Punctuation Errors, SB = Substitution Errors, SP = Spacing Errors, TOTAL = Total Errors, TTOT = Total Typographical Errors, TX = Text Errors. A dash (--) indicates no data because the group made no errors in that category.

Table 8

Word Processing Errors by Group--Document Five: Hearing (n = 6) and Deaf (n = 6)

Error no.	Error type	Hear mean	Hear SD	Deaf mean	Deaf SD	Mann-Wh U	z score
E1	SB	--	--	--	--	--	--
E2	SB	0.17	0.41	--	--	15.0	-1.00
E3	SB	--	--	1.33	2.07	12.0	-1.48
E4	SB	0.67	1.63	0.50	1.22	17.5	-0.12
E5	SB	--	--	--	--	--	--
E6	SB	--	--	--	--	--	--
E7	SB	--	--	0.83	0.98	9.0	-1.90
E8	OM	--	--	--	--	--	--
E9	OM	--	--	--	--	--	--
E10	OM	0.67	0.82	1.17	0.75	11.5	-1.11
E11	OM	0.33	0.82	0.33	0.82	18.0	0.00
E12	EX	0.50	0.84	0.67	1.03	17.0	-0.19
E13	EX	0.50	0.55	1.50	3.67	13.5	-0.87
E14	EX	0.83	1.17	3.00	4.65	14.5	-0.60
E15	EX	1.00	2.45	0.83	2.04	17.5	-0.12
E16	EX	0.16	0.41	0.50	1.23	17.5	-0.12
E17	MF	0.17	0.41	0.33	0.52	15.0	-0.64
E18	TX	1.83	1.47	3.00	3.40	16.0	-0.33
E19	TX	0.50	0.55	0.50	0.84	16.5	-0.27
E20	TX	1.00	1.10	0.17	0.41	10.5	-1.44
E21	TX	0.17	0.41	--	--	15.0	-1.00
E22	TX	--	--	--	--	--	--
E23	TX	0.50	0.84	0.17	0.41	14.5	-0.74
E24	PN	0.33	0.52	0.33	0.52	18.0	0.00
E25	SP	1.00	1.27	0.50	1.23	13.0	-0.96
E26	SP	--	--	3.67	3.50	6.0	-2.28*
E27	SP	0.50	0.55	0.50	0.55	18.0	0.00
E28	SP	0.83	1.60	0.17	0.41	14.5	-0.74
FTOT		5.00	5.22	11.00	9.36	8.5	-1.54
TTOT		6.67	6.12	9.00	6.26	15.0	-0.48
TOTAL		11.67	8.48	20.00	13.89	11.0	-1.12

Note. EX = Extraneous Errors, FTOT = Total Formatting Errors, MF = Miscellaneous Formatting Errors, OM = Omission Errors, PN = Punctuation Errors, SB = Substitution Errors, SP = Spacing Errors, TOTAL = Total Errors, TTOT = Total Typographical Errors, TX = Text Errors. A dash (--) indicates no data because the group made no errors in that category.
*$p < .05$.

Table 9

Word Processing Errors by Group--Document Six: Hearing (n = 4) and Deaf (n = 4)

Error no.	Error type	Hear mean	Hear SD	Deaf mean	Deaf SD	Mann-Wh U	z score
E1	SB	--	--	--	--	--	--
E2	SB	--	--	3.75	7.50	6.0	-1.00
E3	SB	--	--	--	--	--	--
E4	SB	--	--	--	--	--	--
E5	SB	--	--	--	--	--	--
E6	SB	--	--	--	--	--	--
E7	SB	--	--	--	--	--	--
E8	OM	--	--	--	--	--	--
E9	OM	--	--	--	--	--	--
E10	OM	--	--	0.25	0.50	6.0	-1.00
E11	OM	--	--	0.25	0.50	6.0	-1.00
E12	EX	--	--	0.50	0.57	4.0	-1.53
E13	EX	0.25	0.50	2.50	5.00	7.5	-0.19
E14	EX	--	--	--	--	--	--
E15	EX	--	--	--	--	--	--
E16	EX	--	--	--	--	--	--
E17	MF	0.50	0.58	0.50	0.58	8.0	0.00
E18	TX	0.75	0.96	0.50	0.58	7.0	-0.32
E19	TX	0.25	0.50	0.25	0.50	8.0	0.00
E20	TX	--	--	0.75	0.96	4.0	-1.51
E21	TX	0.25	0.50	0.25	0.50	8.0	0.00
E22	TX	--	--	0.25	0.50	6.0	-1.00
E23	TX	0.25	0.50	0.25	0.50	8.0	0.00
E24	PN	0.50	1.00	--	--	6.0	-1.00
E25	SP	--	--	--	--	--	--
E26	SP	--	--	0.50	1.00	6.0	-1.00
E27	SP	--	--	--	--	--	--
E28	SP	--	--	--	--	--	--
FTOT		0.75	0.96	7.75	7.63	2.0	-1.76
TTOT		2.00	3.37	2.75	2.22	6.0	-0.59
TOTAL		2.75	4.19	10.50	9.11	3.0	-1.48

Note. EX = Extraneous Errors, FTOT = Total Formatting Errors, MF = Miscellaneous Formatting Errors, OM = Omission Errors, PN = Punctuation Errors, SB = Substitution Errors, SP = Spacing Errors, TOTAL = Total Errors, TTOT = Total Typographical Errors, TX = Text Errors. A dash (--) indicates no data because the group made no errors in that category.

The only statistically significant difference observed ($z \leq -1.96$ or $z \geq 1.96$, $p \leq .05$) between the two groups was on Document 5 (Table 8), Error Number 26 (Extraneous Spacing Errors). In this category, the deaf students made significantly more errors than did the hearing students ($U = 6.0$, $z = -2.28$, $p < .05$). It should be noted that Document 5 was lengthier than the other five documents and contained more complicated formatting executions.

It may be of interest to examine non-significant comparisons that approached statistical significance using the criterion of 1.5 standard deviations above or below the mean. There were 10 categories in which deaf students made more errors than hearing students. On Document 1 (Table 4) the categories were (a) Error 14 (Extraneous Hard Returns in Place of Word Wrap)($U = 38.5$, $z = -1.61$, $p > .05$), (b) Error 20 (Wrong Word)($U = 31.5$, $z = -1.81$, $p > .05$), and (c) Total Errors ($U = 28.0$, $z = -1.70$, $p > .05$). The deaf group had higher means on error categories in Document 4 (Table 7) as follows: (a) Error 19 (Omitted Words)($U = 13.0$, $z = -1.64$, $p > .05$) and (b) Error 26 (Extraneous Spacing)($U = 13.5$, $z = -1.66$, $p > .05$). Document 5 (Table 8) produced higher deaf means for (a) Error 7 (INDENT/Tab Substitution) ($U = 9.0$, $z = -1.90$, $p > .05$) and (b) Total Formatting Errors

(U = 8.5, z = -1.54, p > .05). The last three categories with higher deaf means found on Document 6 (Table 9) were (a) Error 12 (Command Used in Error)(U = 4.0, z = -1.53, p > .05), (b) Error 20 (Wrong Word)(U = 4.0, z = -1.51, p > .05), and (c) Total Formatting Errors (U = 2.0, z = -1.76, p > .05).

Hearing students generated higher errors in four categories on individual documents. In Document 2 (Table 5), the hearing students had a higher mean for Error 10 (Omitted Hard Returns)(U = 29.0, z = -1.56, p > .05). The same was true in Document 3 (Table 6) for Error 19 (Omitted Word)(U = 20.0, z = -1.57, p > .05). In two additional categories in Document 4 (Table 7), hearing students scored higher than deaf students as follows: (a) Error 27 (State/Zip Code Spacing Error)(U = 14.0, z = -1.61, p > .05) and (b) Error 28 (Miscellaneous Spacing Omission Errors)(U = 14.0, z = -1.88, p > .05).

Table 10 contains statistics for the six document average scores for both groups. The only statistically significant difference was also with Error Number 26 (Extraneous Spacing Errors), with the deaf students generating statistically greater errors in that category (U = 6.0, z = -1.96, p < .05).

There is only one non-significant comparison that approaches significance for the hearing group. This is

Table 10

Word Processing Errors by Group--Document Means for Six Documents: Hearing (n = 11) and Deaf (n = 11)

Error no.	Error type	Hear mean	Hear SD	Deaf mean	Deaf SD	Mann-Wh U	z score
E1	SB	0.10	0.23	0.14	0.35	17.5	-0.12
E2	SB	0.05	0.08	0.65	1.52	17.5	-0.10
E3	SB	--	--	0.22	0.54	15.0	-1.00
E4	SB	0.11	0.27	0.13	0.22	16.0	-0.42
E5	SB	0.08	0.12	0.09	0.17	18.0	0.00
E6	SB	--	--	0.02	0.06	15.0	-1.00
E7	SB	0.05	0.12	0.19	0.34	14.5	-0.74
E8	OM	--	--	0.03	0.08	15.0	-1.00
E9	OM	0.07	0.18	--	--	15.0	-1.00
E10	OM	0.23	0.31	0.37	0.45	14.0	-0.66
E11	OM	0.06	0.14	0.14	0.15	13.0	-0.96
E12	EX	0.08	0.20	0.24	0.29	12.0	-1.15
E13	EX	0.26	0.23	0.92	0.94	10.0	-1.29
E14	EX	0.32	0.41	0.83	1.15	14.0	-0.65
E15	EX	0.19	0.40	0.21	0.35	18.0	0.00
E16	EX	0.12	0.23	0.13	0.22	18.0	0.00
E17	MF	0.20	0.18	0.21	0.20	18.0	0.00
E18	TX	1.05	0.59	1.22	0.94	18.0	0.00
E19	TX	0.37	0.24	0.36	0.28	16.5	-0.24
E20	TX	0.37	0.41	0.47	0.22	13.0	-0.80
E21	TX	0.17	0.15	0.08	0.10	11.5	-1.08
E22	TX	0.14	0.21	0.29	0.43	15.5	-0.45
E23	TX	0.21	0.20	0.09	0.11	11.5	-1.08
E24	PN	0.30	0.25	0.16	0.19	11.0	-1.17
E25	SP	0.48	0.33	0.19	0.22	6.5	-1.87
E26	SP	0.16	0.20	1.12	1.32	6.0	-1.96*
E27	SP	0.18	0.28	0.11	0.20	16.5	-0.29
E28	SP	0.29	0.31	0.10	0.09	11.0	-1.14
FTOT		1.92	1.97	4.52	4.26	9.5	-1.36
TTOT		3.72	2.16	4.18	2.69	17.5	-0.08
TOTAL		5.63	3.93	8.70	6.43	14.0	-0.64

Note. EX = Extraneous Errors, FTOT = Total Formatting Errors, MF = Miscellaneous Formatting Errors, OM = Omission Errors, PN = Punctuation Errors, SB = Substitution Errors, SP = Spacing Errors, TOTAL = Total Errors, TTOT = Total Typographical Errors, TX = Text Errors. A dash (--) indicates no data because the group made no errors in that category.
*$p < .05$.

for Error 25 (Sentence Spacing Omission Errors)(U = 6.5, z = -1.87, p > .05).

For errors that approached significance, there was a pattern for the hearing group. All five error categories with higher means involved omissions. There were four typographical errors (Errors 19, 25, 27, and 28) and one formatting error (Error 10). Similar to the hearing subjects, the deaf subjects also produced higher non-significant means in four typographical categories (Errors 19, 20 [in two documents], and 26). There were more formatting errors with higher means for the deaf students (Errors 7, 12, and 14) than for hearing subjects (Error 10). In Documents 5 and 6, deaf subjects produced higher means for Total Formatting Errors, and Document 1 contained a higher mean for Total Errors for this group. There was no pattern to the errors with higher means for the deaf group as three of these errors were extraneous (Errors 12, 14, and 26), three were substitutions (Errors 7 and 20 [on two documents]), and one was an omission (Error 19). Because of the small number of subjects and documents involved in this study, the above-described non-significant results should be interpreted with caution and not construed as significant differences.

The absence of significant differences (with the exception of Error 26) indicates that the deaf and hearing

students did not perform significantly differently on the various formatting and typographical errors.

Hypothesis 2

In order to determine how many students in each group did not meet job-ready standards, each student's average Total Formatting Errors, Total Typographical Errors, and Total Errors for the six documents were determined and compared to the job-ready standards. No more than an average of five errors in each of the Formatting and Typographical Error categories were allowed. No more than an average of eight Total Errors were allowed. Table 11 shows individual student means and standard deviations for Total Formatting Errors. Also included is the total number of documents (from the six examined in this study) completed by each student. Table 11 reveals that only two deaf subjects were below job-ready standards in Total Formatting Errors. Table 12 shows similar statistics for the Total Typographical Errors. Four deaf students and four hearing students were below job-ready standards in this category. Table 13 displays statistics for the Total Errors made by each student. Only two hearing (18%) and four deaf (36%) students failed to meet job-ready standards in this category.

The results showed that fewer than half of the students in each group failed to meet job-ready standards,

Table 11

Total Formatting Errors by Subject

Subject number	Mean	SD	Documents completed
	Hearing students (n = 11)		
1	1.83	1.94	6
2	4.60	5.46	5
3	1.50	2.38	4
4	0.00	0.00	1
5	1.80	2.17	5
6	0.00	0.00	1
7	3.50	5.65	6
8	0.50	0.71	2
9	0.33	0.58	3
10	0.67	1.21	6
11	0.17	0.41	6
	Deaf students (n = 11)		
12	1.00	0.00	1
13	2.83	2.86	6
14	3.83	4.31	6
15	0.50	0.58	4
16	0.00	0.00	3
17	2.33	3.21	3
18	4.33	3.72	6
19	4.00	4.53	5
20	5.83*	7.03	6
21	0.67	0.58	3
22	29.00*	0.00	1

*Not job ready (over 5 average errors).

Table 12

Total Typographical Errors by Subject

Subject number	Mean	SD	Documents completed
	Hearing students (n = 11)		
1	5.33*	3.33	6
2	7.00*	5.29	5
3	5.00	2.31	4
4	0.00	0.00	1
5	8.60*	5.18	5
6	2.00	0.00	1
7	1.17	1.94	6
8	7.00*	9.90	2
9	0.67	1.15	3
10	0.17	0.41	6
11	0.67	0.82	6
	Deaf students (n = 11)		
12	8.00*	0.00	1
13	4.33	3.78	6
14	3.00	3.69	6
15	2.25	3.30	4
16	4.33	2.08	3
17	3.33	1.53	3
18	2.67	2.66	6
19	0.60	0.89	5
20	5.83*	4.83	6
21	8.33*	5.86	3
22	16.00*	0.00	1

*Not job ready (over 5 average errors).

Table 13

Total Errors by Subject

Subject number	Mean	SD	Documents completed
	Hearing students (n = 11)		
1	7.17	3.76	6
2	11.60*	8.79	5
3	6.50	4.36	4
4	0.00	0.00	1
5	10.40*	7.02	5
6	2.00	0.00	1
7	4.67	7.53	6
8	7.50	10.61	2
9	1.00	1.73	3
10	0.83	1.60	6
11	0.83	1.17	6
	Deaf students (n = 11)		
12	9.00*	0.00	1
13	7.17	6.24	6
14	6.83	6.49	6
15	2.75	3.77	4
16	4.33	2.08	3
17	5.67	4.73	3
18	7.00	4.34	6
19	4.60	5.13	5
20	11.67*	9.48	6
21	9.00*	6.08	3
22	45.00*	0.00	1

*Not job ready (over 5 average errors).

although twice as many deaf students as hearing students failed to meet these standards.

Hypothesis 3

A chi-square test of independence was used to determine whether there was a significant difference in the number of students meeting job-ready standards in each group (deaf and hearing). Separate comparisons were made for Total Formatting Errors, total Typographical Errors, and Total Errors. Table 14 contains the frequencies, percentages, chi-square scores, degrees of freedom (df), and significance levels for each of the three error categories. There were no statistically significant differences ($p > .05$) in any error category.

It is apparent that the number of deaf students failing to meet job-ready standards was not significantly higher than the number of hearing students with similar failures.

Hypothesis 4

The fourth hypothesis sought to determine whether either group (deaf or hearing) collectively met job-ready standards. A z-ratio was used to compare each group's (six-document) average Total Formatting Errors, Total Typographical Errors, and Total Errors to the expected job-ready mean of no more than five errors for each of the

Table 14

Contingency Tables for the Comparisons of Hearing (N = 11) and Deaf (N = 11) Students on Meeting Job-ready Standards Based on (a) Total Formatting Errors, (b) Total Typograhical Errors, and (c) Total Errors

Meets Job-ready Standards (Total Formatting Errors)

		Yes	No	Row total
Hearing		11 100%	0 0%	11 50%
Deaf		9 82%	2 18%	11 50%
	Column total	20 91%	2 9%	22 100%

$\chi^2(1, N = 22) = 2.20, p > .05$

Meets Job-ready Standards (Total Typographical Errors)

		Yes	No	Row total
Hearing		7 64%	4 36%	11 50%
Deaf		7 64%	4 36%	11 50%
	Column total	14 64%	8 36%	22 100%

$\chi^2(1, N = 22) = .00, p > .05$

Table 14 (continued)

Meets Job-ready Standards (Total Errors)

		Yes	No	Row total
Hearing		9 82%	2 18%	11 50%
Deaf		7 64%	4 36%	11 50%
	Column total	16 73%	6 27%	22 100%

$\chi^2(1, N = 22) = .92, p > .05$

first two categories, and no more than eight errors for the third. Table 15 contains the means, standard deviations, *t*-ratio values, and probabilities (*p*) for each of the three categories for the hearing subjects. The hearing group made statistically significantly fewer than an average of five Formatting Errors ($p < .05$). This same group performed similarly to acceptable standards in Total Typographical ($p > .05$) and in Total Errors ($p > .05$). Table 16 shows similar statistics for the deaf group. The deaf group performed similarly to that expected for acceptable job-ready standards ($p > .05$). These results indicate that both groups, collectively, met job-ready standards in all three error categories.

Table 15

Comparison of Job-ready Standards with Means and Standard Deviations on Total Formatting, Total Typographical, and Total Errors for a Group of Hearing Students (N = 6)

Type of error	Mean	(SD)	Job-ready standard	t-ratio	p
Total Formatting	1.92	(1.97)	5.00	-3.83	.01
Total Typo.	3.72	(2.16)	5.00	-1.46	.21
Total	5.63	(3.93)	8.00	-1.48	.20

Table 16

Comparison of Job-ready Standards with Means and Standard Deviations on Total Formatting, Total Typographical, and Total Errors for a Group of Deaf Students (N = 6)

Type of error	Mean	(SD)	Job-ready standard	t-ratio	p
Total Formatting	4.52	(4.26)	5.00	-0.28	.79
Total Typo.	4.18	(2.69)	5.00	-0.75	.49
Total	8.70	(6.43)	8.00	0.27	.80

CHAPTER 5

SUMMARY, DISCUSSION, RECOMMENDATIONS, APPLICATIONS, AND CONCERNS

Summary

Purpose

The purposes of this study, as outlined in Chapter 1, were (a) to determine whether deaf and hearing students performed different quantities of errors on word processing documents in a mainstreamed class and (b) to determine whether the students measured up to job-ready work quality standards. Two research questions were posed to address these concerns as follows:

1. Do deaf and hearing students, provided with identical teaching materials and methods and clear instructor communication, produce different quantities of performance errors on word processing documents in a mainstreamed adult education classroom?

2. Did the deaf and hearing students in the pilot study for the Direct Instructor Communication in ASL model perform a quality of work that meets entry-level word processing job requirements?

Method

Subjects. Subjects were 11 deaf and 11 hearing adult students who were enrolled in the author's mainstreamed WordPerfect word processing course.

Documents. Six representative documents were selected for analysis in this study to compare formatting and typographical errors made by the students in both groups. A list of 28 errors (both formatting and typographical) was prepared prior to the analysis.

Analyses. Each student's documents were analyzed through four phases, described as (a) proof reading, (b) running the Spell Check feature, (c) using the Disk Comparison feature to compare each document against a perfectly keyed original, and (d) checking for errors through the use of the Reveal Code screen.

The data obtained from this study were analyzed with a Mann-Whitney U test to compare average error rates by group for each document, as well as the average by group for all six documents. In addition, student error averages were compared with job-ready performance standards to determine the job-ready status of each subject. A chi-square test of independence was used to determine whether the numbers of job-ready students in the deaf and hearing groups were significantly different. Finally, a *z*-ratio

was used to compare (six-document) group average error rates to the acceptable job-ready standard means.

Results

The key findings of this study were as follows:

1. Deaf and hearing students did not make a significantly different quantity of overall performance errors on word processing documents. Extraneous Spacing Errors were significantly higher for the deaf students, but this was the only exception.

2. For error comparisons that approached significance (greater than 1.5 standard deviations), the hearing subjects had higher means on four typographical errors and one formatting error. All of these errors were related to omissions. Only one of the formatting errors was found on the overall six-document comparison. The remainder were located on individual document comparisons. The deaf subjects had higher means on four typographical errors, three formatting errors, two total formatting error comparisons, and one total error comparison. All of these were found on individual document comparisons. There were no patterns found for errors approaching significance for the deaf subjects. These results should not be considered of any substantive significance for the purposes of this study.

3. The majority of deaf and hearing students met job-ready work quality standards.

4. The number of deaf students failing to meet job-ready standards was not significantly higher than the number of hearing students with a similar failure rate.

5. Both groups collectively met job-ready standards.

Discussion

A major outcome of this study was the further support of the educational model developed by the researcher (Berkay, 1990). The previous study measured the quantity of performance through examination of the average hours required to complete an exercise. This study, which measured the quality of performance through examination of errors, further strengthens the original findings that both deaf and hearing students perform similarly to one another in a mainstreamed classroom setting.

Although there is a paucity of literature comparing the performance of deaf and hearing adult education students, this study is consistent with previous findings in other postsecondary settings. Jones and Murphy (1979) suggested that deaf students can successfully compete with hearing students with proper accommodations. Grade point averages of deaf and hearing students were not found to be significantly different in research reported by Murphy (1976a) and Culton (1975). In concert with the previous

findings, this study did not produce significant differences in deaf and hearing performance.

Not all results were consistent with existing literature. Previous findings stated that deaf students do not perform equally to their hearing peers on language-related subjects (Culton, 1975; Malone, 1986; Rosenberg, 1974). As the subject matter of this course was directly related to the English language, the results of equal performance between the two groups appear to contradict these previous assertions. It is important to point out, however, that a selection factor may have been operating for the deaf subjects, such that those deaf adults who were more comfortable with English may have been more likely to take a word processing course than those who were not at ease with the language.

Although the effects of special deaf accommodations on the performance of hearings students were not specifically examined in this study, it should be noted that the model used was previously subjected to such an examination by Berkay (1990). In that investigation, it was discovered that the performance of hearing students in the mainstreamed course used in this study was not significantly different from the performance of hearing students in a non-mainstreamed course taught by the same instructor the previous quarter. Ruggiero (1986) reported that hearing

students were unaffected by the presence of open captions, a deaf classroom accommodation.

Recommendations

Directions for Future Research

Because of the limitations involved in this study, it is recommend that future research be conducted. Some of the limitations and possible solutions are as follows:

1. The small sample sizes (n = 11 for each group) limited the ability to generalize to a target population. The subjects were not evenly distributed by sex, and their ages were never determined. A future study might include a larger number of subjects, evenly distributed by sex. Age data could be collected to determine the mean age of the subjects.

2. Another limitation was that the subjects were not asked to strive for a specific standard of work quality. In a future study, students could receive grades based on a specific allowable number of performance errors. This could provide adequate motivation for achieving an even higher number of students measuring up to job-ready standards.

3. The course itself was not designed to produce job-ready students. It is recommended that a course used in a future study might have a curriculum designed to produce job-ready students. Students could be pre-screened to

determine suitability for such a course. Prior to commencement of the study, a program evaluation could be performed to determine its success in producing students with marketable word processing skills.

5. One further limitation was that improvement from the beginning to the end of the course could not be analyzed due to the variation in the complexity and length of documents used in this course. In future studies, improvement could be assessed if all of the documents were of equal quality and length.

Applications of Findings and Methodology

Findings

Due to the small sample sizes, the applicability of these findings must be used with caution.

As the deaf and hearing students performed similarly in work quality, it may not be necessary to adapt the teaching materials and methods for a mainstreamed word processing course for deaf adults. Focus instead might be made on the method of communication between the instructor and the deaf students.

As the textbook WordPerfect: Tutorial & Applications by Mary Alice Eisch (1988) was used successfully with this model, it could be considered for use in other mainstreamed or segregated courses for deaf adults. The 5.1 edition of this book is widely used by high schools and

postsecondary institutions across the country as of this writing.

Methodology

The error classification system and data analysis process outlined in Chapter 3 could be used by other researchers to analyze word processing performance errors. This system would have applicability for analyzing documents produced by non-deaf populations. It is hoped that others will replicate the Direct Instructor Communication model with larger samples in order to contribute to the improvement of the quality of deaf adult education on a nationwide basis.

Concern

There is one major concern of this author that should be noted at this time. As knowledge of deafness and the ability to communicate with deaf adults is necessary to the success of a program such as the one described in this investigation, it is strongly recommended that only those individuals with appropriate expertise establish such programs. Those lacking expertise in this field should contact a local deaf services center in order to locate a qualified instructor to teach a mainstreamed course under the Direct Instructor Communication model.

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